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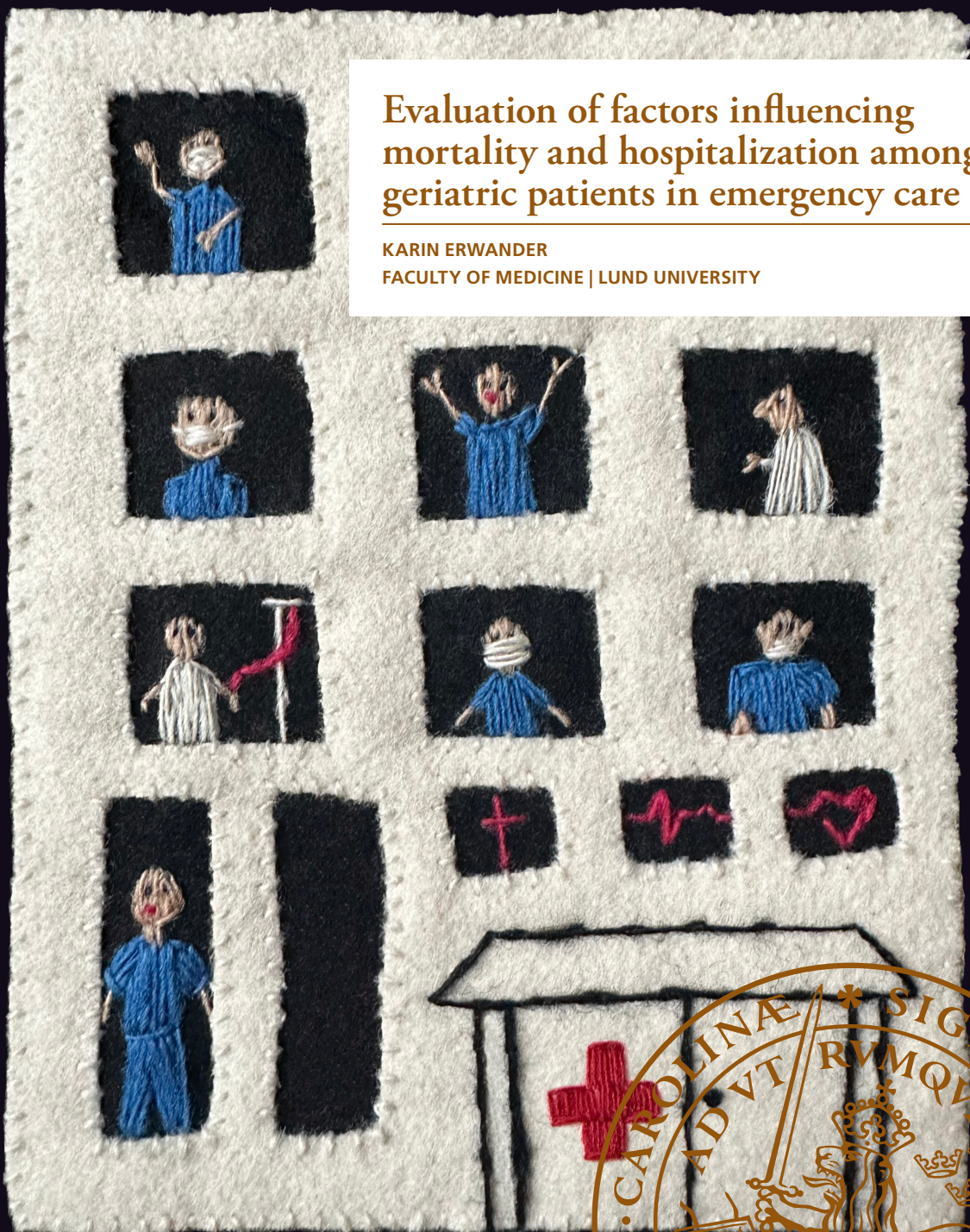
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Evaluation of factors influencing mortality and hospitalization among geriatric patients in emergency care

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FACULTY OF MEDICINE | LUND UNIVERSITY



Evaluation of factors influencing mortality and hospitalization among geriatric patients in emergency care

Karin Erwander, MD



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DOCTORAL DISSERTATION

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Dorota Religa, Professor, Geriatrics, Karolinska institutet, Department of Neurobiology, Care Sciences and Society, Stockholm, Sweden

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Abstract:

Background : With a growing aging population, emergency departments (ED) face increasing challenges in managing frail older adults with multiple comorbidities. These patients are at high risk for complications, increased resource utilization, and poorer outcomes. This thesis examines key factors influencing ED visits, admission rates, and mortality in geriatric emergency medicine to optimize care, improve protocols, and enhance patient safety.

Method : Paper I is a retrospective cohort study investigating the relationship between ED admissions and in-hospital bed occupancy. Paper II is a retrospective pre-post intervention study evaluating whether a mobile team intervention reduces ED visits among older patients receiving municipal home care (MHC). Papers III and IV are retrospective observational studies: Paper III explores the association between chief complaints, admission rates, and 30-day mortality, while Paper IV examines 7-day mortality in relation to vital signs recorded at ED triage.

Results : Paper I found that primary triage referral patterns remain stable despite high in-hospital bed occupancy. Paper II found no significant reduction in ED visits or admissions for the mobile team intervention group. Paper III showed that patients with non-specific complaints (NSC) had a high admission rate and 30-day mortality. Paper IV found that low systolic blood pressure (SBP), high heart rate, low oxygen saturation, and impaired level of consciousness (LOC) were independently associated with 7-day mortality, though none were sufficiently predictive on their own: LOC and SBP showed the strongest associations, underscoring the need for multifactorial triage in geriatric emergency care.

Conclusion : This thesis highlights key system and clinical gaps in emergency care for older adults. Across four studies, it shows that current triage, risk assessment, and care models are poorly aligned with geriatric needs. Findings call for age-adapted triage protocols, better integration of frailty and cognitive assessments, and more targeted community interventions. This work advocates for a more holistic, patient-focused approach to emergency care that better addresses the complex needs of the growing population of older adults.

Key words: emergency care, elderly patients, geriatric emergency medicine, geriatrics, hospital admission, non-specific complaints, triage, vital signs

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Karin Erwander, MD



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MADE IN SWEDEN 



Till Pappa Bosse Erwander

Det har visat sig att jag saknar dig också.

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Original papers

The thesis is based on the following papers, which will be referred to by their Roman numerals.

- I. Blom MC, Erwander K, Gustafsson L, Landin-Olsson M, Jonsson F, Ivarsson K. *Primary triage nurses do not divert patients away from the emergency department at times of high in-hospital bed occupancy - a retrospective cohort study*. BMC Emerg Med. 2016 Sep 22;16(1):39. doi: 10.1186/s12873-016-0102-5. Published: September 22nd, 2016
- II. Erwander, K., Ivarsson, K. & Agvall, B. *Association between a mobile team intervention in Swedish municipal home care and the effect on emergency department visits and hospitalizations among older adults*. BMC Health Serv Res 25, 674 (2025). <https://doi.org/10.1186/s12913-025-12843-1> Published: May 10th, 2025
- III. Erwander K, Ivarsson K, Olsson ML, Agvall B. *Elderly patients with non-specific complaints at the emergency department have a high risk for admission and 30-days mortality*. BMC Geriatr. 2024 Jan 3;24(1):5. doi: 10.1186/s12877-023-04621-7. Published: January 3rd, 2024
- IV. Erwander K, Agvall B, Ivarsson K. *The role of vital signs in predicting mortality risk in elderly patients visiting the emergency department*. BMC Emerg Med. 2025 Aug 1;25(1):144. doi: 10.1186/s12873-025-01307-8. Published: August 1st, 2025

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Related publication not included in this thesis:

Blom MC, Erwander K, Gustafsson L, Landin-Olsson M, Jonsson F, Ivarsson K. *The probability of readmission within 30 days of hospital discharge is positively associated with inpatient bed occupancy at discharge--a retrospective cohort study.* BMC Emerg Med. 2015 Dec 14;15:37.

Erwander, K., Ivarsson, K., Landin-Olsson, M., & Agvall, B. (2022). *Pre-hospital conditions affecting the hospitalization risk in older adults at the Emergency Department.* Journal of Geriatric Emergency Medicine, 3(3), 1-12.
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My contributions to the papers

For the publications included in my doctoral thesis I served as the primary author for paper II through IV and as a co-author in paper I. My specific contributions for each paper are as follows:

Paper I: I assisted in drafting, writing and revising the manuscript, while also managing communication with the journal. I contributed to the data analysis and played a significant role in synthesizing the results. Furthermore, I was involved in developing and designing the figures and tables included in the paper.

Paper II: I participated in the study design, the ethical application process, and data collection. I was responsible for the data analysis, including statistical evaluations and result synthesis. In addition, I led the manuscript writing and managed all communications with co-authors and journal throughout.

Paper III: I defined the research question and led the overall study design, overseeing data collection, processing, and analysis. I drafted and revised the manuscript while coordinating communications with co-authors and the journal.

Paper IV: As the primary author, I led the study design and supervised data collection. I was responsible for gathering, processed, and analysing data, as well as creating the figures and tables presented in the paper. I also drafted and revised the manuscript and managed all communications with co-authors and the journal during the entire process.

Abstract

Background : With a growing aging population, emergency departments (ED) face increasing challenges in managing frail older adults with multiple comorbidities. These patients are at high risk for complications, increased resource utilization, and poorer outcomes. This thesis examines key factors influencing ED visits, admission rates, and mortality in geriatric emergency medicine to optimize care, improve protocols, and enhance patient safety.

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Conclusion : This thesis highlights key system and clinical gaps in emergency care for older adults. Across four studies, it shows that current triage, risk assessment, and care models are poorly aligned with geriatric needs. Findings call for age-adapted triage protocols, better integration of frailty and cognitive assessments, and more targeted community interventions. This work advocates for a more holistic, patient-focused approach to emergency care that better addresses the complex needs of the growing population of older adults.

Abbreviations

ACEP	American College of Emergency Physicians
CCI	Charlson Comorbidity Index
CGA	Comprehensive Geriatric Assessment
CFS	Clinical Frailty Scale
COPD	Chronic Obstructive Pulmonary Disease
ED	Emergency Department
ED LOS	Emergency Department Length of Stay
FRESH	Frail Elderly Support Research Group
GCS	Glasgow Coma Scale
GED	Geriatric Emergency Department
HR	Heart Rate
LOC	Level of consciousness
LOS	Length of Stay
MHC	Municipality Home Care
NSC	Non-Specific Complaint
PCP	Primary Care Physician
PHC	Primary Healthcare Centre
RETTTS-A	Rapid Emergency Triage and Treatment System - Adult
RHIP	Regional Healthcare Information Platform
RLS	Reaction Level Scale
RR	Respiratory Rate
SAEM	Society for Academic Emergency Medicine
SALAR	Swedish Association of Local Authorities and Regions
SBP	Systolic Blood Pressure
SpO ₂	Oxygen Saturation
WHO	World Health Organization

Introduction

The primary objective of the studies underlying this doctoral thesis was to identify and analyse factors influencing admission rates and mortality in geriatric emergency medicine, with the aim of optimizing patient outcomes. Older adults are often frail and have a high prevalence of multimorbidity, rendering them particularly vulnerable to the adverse effects during Emergency Department (ED) visits and hospitalizations. Their complex medical needs lead to higher resource utilization in the ED and an increased risk of adverse events. Addressing these challenges requires optimizing the management and care logistics for geriatric patients to better meet the demands of an aging population. This thesis offers insights into the conditions that elevate the risk of admission and mortality, providing evidence-based knowledge to inform protocol adjustments in ED settings and ultimately improve outcomes for older adults in emergency care.

Research gaps in geriatric emergency medicine

Despite the rising demand for emergency care among older adults, research in geriatric emergency medicine remains underdeveloped. Older patients are underrepresented in clinical trials, particularly those with frailty, multimorbidity, or cognitive impairment despite these being defining features of the population (1, 2). Many existing emergency care protocols are not well-suited to the atypical presentations and complex needs seen in geriatric patients, leading to diagnostic delays, under-triage, and suboptimal outcomes (3-5).

One critical gap lies in the lack of geriatric-specific triage models. Traditional triage systems prioritize acute symptoms and vital signs based on norms derived from younger populations, overlooking subtle signs of deterioration common in older adults (6, 7). Non-specific complaints (NSC) such as generalized weakness or confusion are often dismissed or under-triaged, despite being associated with high morbidity and mortality (8, 9). Similarly, frailty and functional decline are rarely accounted for in ED workflows, despite their known predictive value for adverse outcomes (10).

Although the effects of an aging population on ED crowding and hospital bed occupancy are recognized, there is a lack of system-level research that quantifies these impacts or offers

effective solutions in many healthcare systems (11). While mobile medical teams and hospital-at-home interventions have been introduced to manage care outside the ED, their effectiveness in reducing acute care utilization remains unclear, with mixed evidence across studies (12-14). Finally, delirium, polypharmacy, and inadequate discharge processes are widely recognized problems in geriatric care, yet few targeted interventions have been rigorously evaluated in the emergency context (15-18).

Rationale for focus areas

Considering these research gaps in geriatric emergency medicine, this thesis focuses on four key areas that are clinically relevant: ED crowding, mobile teams, NSC and vital signs in triage. These were selected because they represent major points of vulnerability for older adults and offer opportunities for system-level and bedside improvements.

ED crowding is a growing challenge in Sweden and globally, disproportionately affecting older adults who require longer evaluations and are more likely to be admitted. Understanding the factors that contribute to crowding particularly among the geriatric population is essential to optimize patient flow and resource use.

Mobile healthcare teams represent a potential solution to ED overutilization by addressing acute needs in the home. However, their real-world impact on outcomes and resource use in elderly patients is still poorly understood, warranting further investigation.

NSC are one of the most difficult clinical challenges in geriatric emergency medicine. These vague presentations are common, high-risk, and not well supported by existing triage protocols or clinical pathways. Improving risk stratification and care strategies for patients with NSC could reduce missed diagnoses and improve outcomes.

Vital signs are central to ED triage decisions, yet standard thresholds may not reflect the physiological realities of older adults with altered baseline states, polypharmacy, or chronic disease. This thesis examines how age-specific interpretation of vital signs can improve triage accuracy and early detection of serious illness.

Together, these focus areas address both individual-level risk and system-level strain providing evidence to inform safer, more efficient, and more tailored emergency care for older adults.

The aging population

The global population is aging, and every country is witnessing growth in both the absolute number and the proportion of older adults (19). This shift is driven by factors such as longer life expectancy, declining birth rates and improved healthcare (20). In Sweden approximately 20% of the population is over the age of 65, a figure expected to increase to 25% in the coming decades (21). In the past, infectious diseases were the primary burden on the healthcare system. In recent years chronic health problems have taken precedence. Nearly all chronic conditions are closely linked to aging and in recent years, governments and healthcare planners have begun to recognize this significant shift. Common chronic diseases among older adults include hypertension, diabetes, heart disease and respiratory disorders such as chronic obstructive pulmonary disease (COPD). A systematic review article on aging with multimorbidity from 2011 found that even after controlling for various confounding factors, multimorbidity was significantly associated with increased disability, reduced quality of life and higher healthcare utilization and costs (22).

This demographic shift has significant implications for the health care system, leading to increased resource demands and rising healthcare costs (3). Healthcare consumption tends to be higher later in life, with the ED playing a critical role in providing essential services for older adults (23-27).

Multimorbidity in geriatric emergency medicine

Multimorbidity impacts more than half of the elderly population with its prevalence notably higher among the very old, women and individuals from lower socioeconomic backgrounds (22). The most widely accepted definition of multimorbidity is the coexistence of two or more chronic health conditions in a single individual. This person-centred definition, endorsed by the World Health Organization (WHO), does not prioritize one condition over another and reflects the complexity of managing multiple illnesses simultaneously (28-30). These conditions may include chronic physical diseases (diabetes, hypertension, heart failure, COPD), mental health or cognitive disorders (depression, dementia), and persistent infectious diseases (HIV, hepatitis C) (28, 29, 31). Multimorbidity is increasingly recognized as a major public health and clinical challenge, particularly among older adults (32). Common contributors to the growing prevalence of multimorbidity include hypertension, depression or anxiety and chronic pain (33). These conditions illustrate the diverse, overlapping, and interconnected nature of physical and mental health disorders.

The definition of multimorbidity contrasts with the concept of comorbidity, introduced by Feinstein in 1970, which focuses on additional conditions in the context of a single index disease (34). Multimorbidity thus shifts the clinical and research lens toward understanding

the overall burden of illness and its implications for care delivery, especially in the geriatric population. Unfortunately, healthcare systems are typically structured around the management of single diseases rather than addressing the overall needs of individuals with multiple conditions. This approach can result in fragmented or even conflicting care for patients with multimorbidity, ultimately contributing to a higher burden of treatment for these individuals (35, 36).

In scientific studies, multimorbidity can be operationalized in several ways, depending on the research question and available data. The most common methods include (22):

- Disease count: commonly two or three. This approach simply tallies the number of coexisting chronic conditions, typically using a predefined list. It is straightforward and widely used in epidemiological research but does not account for disease severity or functional impact.
- Cumulative comorbidity indices: tools such as the Charlson Comorbidity Index (CCI) and the Elixhauser Comorbidity Index are commonly used to quantify multimorbidity (37-39). These indices assign weighted scores to different conditions based on their association with mortality or resource use. The CCI, for example, includes 17 conditions and is particularly useful in mortality prediction in older adults (38).
- Expanded definitions including functional and cognitive impairment: Multimorbidity is increasingly recognized as encompassing not only the coexistence of multiple diseases or symptoms, but also limitations in cognitive and physical function. To better understand the prevalence and complexity of health problems among older adults, particularly those requiring coordinated care across medical and social services, research has expanded beyond simple disease counts. Instead, it incorporates broader dimensions such as cognitive decline, functional impairment, and psychosocial challenges to more accurately reflect care needs and health outcomes in this population (22).

Each approach has strengths and limitations. Disease counts offer simplicity but may lack nuance, while weighted indices like the CCI improve predictive validity but may exclude relevant geriatric syndromes. Therefore, the choice of method must align with the study's objective, whether descriptive, prognostic, or interventional.

Given the high prevalence and complexity of multimorbidity in older ED patients, selecting appropriate measurement tools is essential for risk stratification, outcome prediction, and the development of tailored care pathways (40).

In emergency medicine, the presence of multimorbidity complicates decision-making and contributes to diagnostic uncertainty, atypical presentations, and prolonged evaluations (28, 41, 42). Evidence shows that multimorbid older adults are at higher risk for adverse outcomes, including hospitalization, functional decline, and mortality following ED visits

(43). Furthermore, the concept of complex multimorbidity, typically defined as three or more chronic conditions affecting different body systems, has been proposed to reflect the higher care needs and system navigation challenges in this subgroup (44).

Despite its clinical importance, multimorbidity remains underrepresented in emergency care research. A lack of consensus on standard definitions, inconsistent documentation in ED settings, and the inherent time constraints of acute care hinder accurate assessment and integration into triage systems. Understanding and appropriately characterizing multimorbidity is critical for improving acute care planning, optimizing resource use, and designing interventions that better serve the growing geriatric population (45-47).

Frailty

Frailty is one of the most significant manifestations of an aging population. It represents a clinical syndrome marked by decreased physiological reserves, vulnerability to stressors and an increased risk of adverse health outcomes (48, 49). Frail patients typically require more healthcare resources in both primary care and in-hospital setting (50). Although not all older adults are frail, assessing frailty is crucial in the ED as it helps determine the urgency and type of care needed to optimize recovery and maintain quality of life (51). A Swedish study from 2023 found that 57% of older adults in the ED are frail (52). Various screening instruments for frailty are available, with the Clinical Frailty Scale (CFS) and Frail Elderly Support Research Group (FRESH) instrument being the most used in Swedish EDs (53-55).

In recent years there has been a growing interest in Sweden in implementing screening tools to identify frail patients in the ED. The goal of frailty screening is to quickly detect older patients who are at risk for adverse outcomes, such as complications, prolonged hospital stays or readmissions. Using standardized instruments such as CFS or FRESH, ED staff can assess a patient's level of frailty in real time. Early identification of frailty makes it possible to tailor care to the individual needs of the patient. This may include adjusted treatment strategies and multidisciplinary interventions to more comprehensive planning or transitions between different levels of care (56, 57).

Structured frailty screening in the ED promotes a proactive and patient-centred approach to care, which is essential for addressing the challenges associated with an aging population with complex healthcare needs (58). The increasing implementation of frailty screening in Swedish EDs has led to the development of new protocols aimed at optimizing care delivery for this vulnerable patient group. Unfortunately, frailty screening performed in the ED in Sweden is not consistently documented in patient's medical records. This means that the initiatives and assessments made in the ED are not always communicated to the in-hospital wards, complicating studies of its overall impact. This lack of documentation hinders the ability to ensure that elderly patients receive thorough and continuous follow-up care (59).

Geriatric syndrome

Geriatric syndrome refers to a group of multifactorial health conditions commonly seen in older adults that do not fit neatly into a single disease category. These conditions include frailty, falls, delirium, incontinence, and cognitive impairment. The geriatric syndrome arises from the complex interplay of aging-related physiological changes, chronic illnesses, and environmental factors (60-62). In the ED, the presence of geriatric syndromes presents unique challenges. Older patients often exhibit atypical symptoms due to these syndromes, which can complicate diagnosis and delay appropriate treatment. For instance, frailty may mask the severity of an acute condition, leading to under-triage or misdiagnosis, while delirium can obscure the clinical picture, making it difficult for clinicians to accurately assess the patient's true status.

The high prevalence of geriatric syndromes in the ED is associated with increased healthcare utilization, including longer lengths of stay (LOS) and higher rates of hospital admissions. These outcomes not only strain ED resources but also contribute to poorer overall patient outcomes (63). Recognizing these syndromes through targeted assessments such as comprehensive geriatric evaluations can help tailor interventions, improve the accuracy of triage, and optimize care pathways for older adults (64). Integrating a focused approach to managing geriatric syndromes in the ED is essential for enhancing patient safety, reducing unnecessary hospital admissions, and ultimately improving the quality of care for this vulnerable population.

Comprehensive Geriatric Assessment

Comprehensive Geriatric Assessment (CGA) is a multidimensional, interdisciplinary diagnostic process designed to evaluate an older adult's medical, psychosocial, functional and environmental needs. The goal is to develop a coordinated and integrated plan for treatment and long-term follow-up. CGA offers a holistic view of a patient's overall health and functional status leading to more accurate diagnoses, better targeted interventions and improved patient outcomes. By identifying early vulnerabilities such as frailty, risk of falling and issues related to polypharmacy, CGA helps prevent future complications. It also facilitates coordinated care by enhancing communication among various healthcare providers, thereby ensuring more cohesive and continuous management of the patient's health (65, 66).

Using CGA in the ED helps identifying underlying issues that contribute to frequent ED visits and hospital admissions among older adults. CGA can be used to identify geriatric syndromes such as frailty, cognitive impairment or functional decline which might not be apparent through a standard medical evaluation. This allows ED physicians to tailor care, prioritize resources and potentially reduce unnecessary admissions or readmissions by

addressing the root causes of the patient's vulnerability (67). CGA can be time-consuming and resource-intensive, posing significant challenges in the fast-paced environment of the ED. Implementation of CGA in the ED requires a multidisciplinary team which may not be available in all settings. Integrating CGA into existing emergency workflows can be difficult when rapid decision-making is crucial (68, 69).

CGA can reduce the risk of adverse outcomes and improve overall patient care but the integration of CGA into the ED requires balancing thorough assessment with the need for prompt evaluation, making it both a promising and challenging approach. If it is not possible to integrate CGA in the ED, the 5Ms is a possible lighter version of CGA. The 5Ms – Matters most, Medications, Mental status, Mobility and Multi-complexity – provide a structured approach to assess and address the unique needs of geriatric patients. Matters most focuses on understanding the patient's goals and values; Medication emphasizes reviewing and optimizing the patient's medication regimen; Mental status involves assessing cognitive function, mental health and risk for delirium; Mobility examines the patient's physical function and fall risk; and Multi-complexity considers the interplay of multiple chronic conditions and social factors (62, 70). While CGA provides an in-depth evaluation of an older adult's health the 5Ms offer a streamlined approach that addresses key domains critical to geriatric care. This approach is particularly useful when time and resources are limited, allowing clinicians to quickly identify major issues and tailor interventions accordingly without the extensive time commitment required for a full CGA (71).

End-of-life care

End-of-life care in the ED involves unique challenges and opportunities. The ED setting is typically planned towards rapid, life-saving interventions rather than the nuanced, holistic care often needed at the end of life. One of the primary challenges is the limited time available to conduct comprehensive discussions regarding goals of care. The fast-paced ED environment may not allow for extended conversations about a patient's values and preferences. This can lead to interventions that might not align with the patient's wishes, particularly for frail elderly who might benefit more from palliative care rather than curative treatments (72).

Prior studies have shown that nearly 75% of patients had an ED visit during the final six months of their lives (73, 74). Research consistently shows that many patients express a preference to die at home, where they feel most comfortable and safe (75). Despite these wishes the reality is that a significant number of end-of-life patients are transported to the ED during acute episodes of symptom exacerbations of medical emergencies. This transition often occurs due to challenges in managing severe symptoms at home without robust palliative or home health care support. These unplanned ED visits can lead to hospital admissions and ultimately deaths occurring in the hospital rather than at home.

Improving coordination between home care providers and emergency services is essential to bridge the gap. Enhanced communication and advanced care planning can help ensure that a patient's end-of-life wishes are respected and potentially reduce unnecessary ED visits (76). While many patients prefer to die at home, the lack of comprehensive home-based palliative care can lead to ED visits and hospital deaths. Strengthening home care and promoting end-of-life planning are critical steps to help align actual care with patient's preferences (77, 78).

Choosing wisely

The Choosing Wisely initiative emphasizes the need to critically assess diagnostic tests, treatments, and procedures to prevent unnecessary interventions. In 2013, the American College of Emergency Physicians (ACEP) became a part of this campaign and subsequently issued recommendations aimed at delivering high-value, patient-centred care in the ED. ACEP's guidance advises emergency physicians to carefully evaluate whether a specific test or treatment will genuinely benefit the patient, a consideration that is especially important for elderly patients who often present with complex health profiles and multiple chronic conditions (76). Overuse of diagnostics and treatments in this group can lead to harmful side effects, increased costs, and extended hospital stays. By incorporating the principles of Choosing Wisely, ED clinicians are encouraged to adopt evidence-based practices that strike a balance between thorough patient evaluation and the avoidance of redundant care. This approach ensures that older adults receive treatment that is both tailored to their individual needs and safe, while also optimizing resource allocation and reducing the risk of complications such as delirium and iatrogenic harm. A fundamental aspect of the Choosing Wisely philosophy is engaging patients early in discussions about the potential risks and benefits of various tests and treatments. This shared decision-making process allows healthcare providers to align care plans with the patients' own values and preferences. This is a consideration that is particularly crucial for frail elderly individuals for whom aggressive interventions may not be consistent with their overall goals for quality of life.

Ultimately, by reducing unnecessary tests and procedures, the ED can function more efficiently, leading to shorter patient stays and better resource management. For frail elderly patients, adopting the Choosing Wisely approach may significantly lower the risk of adverse outcomes associated with over-testing and overtreatment, thereby contributing to safer and more effective care (79).

Ethical considerations in geriatric emergency care

Ethical dilemmas frequently arise in geriatric emergency care due to complex medical conditions, cognitive impairments, and the proximity of many patients to end of life. Integrating ethical considerations into geriatric emergency care is essential, especially regarding end-of-life decisions and the principles advocated by the Choosing Wisely initiative. The ethical principles, autonomy, beneficence, non-maleficence, and justice, are particularly relevant when caring for older adults (80). Respecting patient autonomy involves acknowledging and supporting an individual's right to make informed decisions about their own care. In geriatric patients, assessing decision-making capacity becomes essential, as cognitive impairments may affect their ability to understand and consent to treatment options. Healthcare providers must carefully evaluate each patient's capacity to ensure that their choices are informed and voluntary (81).

The principles of beneficence (promoting well-being) and non-maleficence (avoiding harm) require clinicians to balance the potential benefits and risks of interventions. In the context of end-of-life care, this balance becomes delicate, as certain treatments may prolong life without enhancing its quality. The Choosing Wisely campaign emphasizes avoiding unnecessary interventions that may not provide meaningful benefit and could cause harm, advocating for care that aligns with the patient's goals and values (76, 79, 82). Determining the medical indication for treatments at the end of life is critical. Administering interventions without clear benefit can lead to patient suffering and resource misallocation. Clinicians are encouraged to critically assess the appropriateness of treatments, considering the patient's overall prognosis and preferences, to prevent overtreatment and ensure care that truly benefits the patient (83). Engaging patients in advance care planning allows them to express their preferences for end-of-life care, ensuring that their autonomy is respected even if they become unable to communicate their wishes later.

Integrating these ethical considerations into geriatric emergency care ensures that treatment decisions are patient-centred, evidence-based, and aligned with the fundamental principles of medical ethics.

Communication challenges in geriatric emergency care

Effective communication is important for high-quality emergency care, particularly among older adults. A combination of patient- and system-level factors significantly hinders communication in the ED, leading to diagnostic delays, inappropriate admissions or discharges, and increased risk of mortality and rehospitalization (84-86).

Sensory impairments, including hearing and visual loss, are common in this population but frequently overlooked in busy ED environments. Such impairments may hinder the comprehension of spoken or written information, especially under conditions of high noise

and poor lighting, leading to misinterpretation of patient responses and inappropriate clinical decisions (87, 88). Cognitive impairment, whether chronic (dementia) or acute (delirium), further complicates communication. Delirium is often underdiagnosed in the ED and can interfere with history taking, consent, and shared decision-making, contributing to adverse outcomes (89-91). Communication style also plays a role. The use of “elderspeak”, a patronizing tone or oversimplified language, may reduce trust and autonomy, particularly among persons living with dementia, and has been associated with increased resistance to care (92, 93).

The ED environment itself, characterized by time pressure, frequent interruptions, and minimal privacy, often exacerbates communication challenges by amplifying stress and reducing comprehension, especially in patients with underlying cognitive or sensory deficits. Inadequate discharge communication and poor coordination with follow-up services are major contributors to fragmented care and avoidable rehospitalizations. Older adults frequently leave the ED without a clear understanding of their diagnosis or next steps, especially when caregivers are not involved in the process (94, 95).

Addressing these challenges requires a structured, person-centred approach that includes early recognition of impairments, respectful communication, involvement of caregivers, and clear discharge planning.

Consequences for healthcare related to an aging population

Emergency care face significant challenges when serving an aging population with multimorbidity. Older adults typically present with multiple chronic conditions and complex health issues which can complicate diagnosis and management in the fast-paced ED environment (3, 62, 96-100).

Individual challenges:

- Complex presentations – Older adults often present with NSC, atypical symptoms, multimorbidity, polypharmacy and frailty complicating diagnosis and treatment
- Higher risk of adverse events – There is an increased likelihood of delirium, falls, medications errors, pressure ulcers, infections
- Fragmented care transitions – Poor continuity between emergency care and primary care can lead to conflicting care plans and inadequate follow-up

ED challenges:

- Increased ED utilization – The ED experiences higher patient volumes as older adults seek care more frequently
- Longer length of stay – Complex cases often require extended evaluation and treatment times
- Increased resource utilization – The complexity of cases results in greater demand for diagnostic and treatment resources
- ED crowding – Increased patient volumes and prolonged stays contribute to overcrowding

In-hospital challenges:

- Longer in-hospital LOS – Older patients often have longer in-hospital LOS
- Higher readmission rates – The complexity of care increases the likelihood of readmissions
- Complex ethical decisions – Managing care for frail older adults frequently involves challenging ethical considerations
- Need for specialized geriatric care – There is a growing demand for tailored care strategies and specialized units to address the unique need of older patients

Society and healthcare challenges:

- Rising healthcare utilization and costs – An aging population drives up healthcare demand and associated costs
- Strain on resources – Increased patient volumes and complexity strains both EDs and hospitals
- Need for integrated and specialized care – There is a need for coordinated care models and specialized services to manage the health challenges of older adults effectively

These challenges underscore the importance of rethinking ED processes and resource allocation to better serve the aging population. The ED is uniquely positioned to play a role in improving care for the geriatric population by addressing these multifaceted issues.

ED utilization by older adults

Older adults visit the ED at a higher rate than younger individuals, often experiencing longer LOS during their visit (101, 102). Statistics from Swedish National Board of Health and Welfare shows that woman and men aged 80 and older were the patient group with the longest LOS at the ED (103). The elderly population accounts for 12% to 21% of all ED encounters and previous studies consistently show that older adults are overrepresented in EDs compared to their proportion in the general population in the same geographic areas. In addition, between one third and one half of all ED visits by older patients result in hospital admission. These rates are 2.5 to 4.6 times higher than those observed in younger patients (3). Figure 1 presents all ED visits in Region Halland during 2023, along with the visits made by patients over 65 years of age, based on data from Swedish Association of Local Authorities and Regions (SALAR). In 2023 patients aged 65 and older accounted for 29% of all ED visits in Region Halland (104).

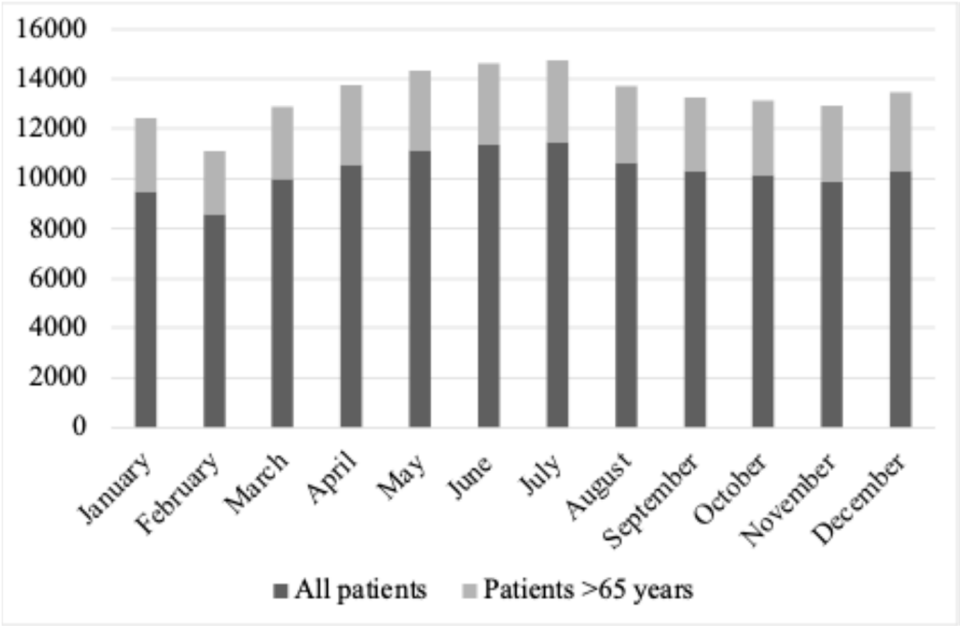


Figure 1 All ED visits in Region Halland during 2023 and ED visits made by patients ≥65 years
Based on data from SALAR

Reasons for ED visits in the elderly population

Older adults frequently visit the ED due to a combination of medical and social factors. Medically, common reasons include cardiovascular issues such as ischemic heart disease, heart failure, cardiac dysrhythmias, syncope, and acute cerebrovascular events. Respiratory problems like pneumonia and COPD also lead to breathing difficulties that often necessitate emergency care. Infections, particularly urinary tract infections and sepsis, can present atypically in older adults, manifesting as confusion or weakness, thereby prompting ED visits. Abdominal disorders resulting in pain, often due to gastrointestinal issues, are frequent complaints among the elderly in emergency settings. Additionally, dehydration is a common concern, as older adults are more susceptible due to factors like reduced thirst sensation and medications affecting fluid balance (3, 105-107).

Surgically, traumatic injuries, predominantly from falls, are prevalent among older adults. Falls are the leading cause of injuries among older adults. Contributing factors include environmental hazards, balance disorders, and visual impairments. Approximately, one in three individuals over 65 experiences a fall each year, increasing to one in two for those over 80. Falls among the elderly result in hospital admissions for 15%–30% of cases, with fractures occurring in up to 20% of these incidents (68, 108-110).

Social factors also significantly contribute to ED visits among older adults. Those living alone or living at home with municipal home care (MHC) or home healthcare services, may lack immediate support, which can lead to more frequent use of emergency care. Economic challenges can limit access to preventive healthcare, resulting in unmanaged chronic conditions that escalate to emergencies. Additionally, a lack of social support may lead to neglect of health needs, increasing the likelihood of conditions worsening to the point of requiring emergency care (111, 112).

Understanding these medical and social determinants is crucial for developing preventive measures and improving healthcare strategies tailored to the unique needs of the older adult population.

ED crowding

The increasing number of elderly patients, with complex and chronic medical conditions, significantly contributes to ED crowding (11). ED crowding occurs when demand for emergency services exceeds available resources or when patient flow is inefficient (113). Crowding was defined in 2006 by the ACEP as “*Crowding occurs when the identified need for emergency services exceeds available resources for patient care in the ED, hospital or both*” (114). The impact of ED crowding is well-documented and has serious consequences, particularly for critically ill patients, potentially leading to delayed treatment and increased

in-hospital mortality (113, 115, 116). ED crowding can also result in ambulance diversions, extended hospital stays and compromised quality of care (117, 118).

ED crowding is often conceptualized in three interrelated components: input, throughput and output. Input refers to the volume and acuity of patients arriving at the ED where non-urgent visits and high-utilizers or “frequent-flyer patients” are major contributors (119, 120). Throughput involves the processes within the ED, including triage, diagnostic testing, treatment and staffing (121, 122). Output factors concern the ability to discharge patients or transfer them to in-patient beds. Waiting for available hospital beds contributes to overall ED crowding (123).

In an international health policy survey from 2021, 20% of Swedish patients aged 65 and older reported visiting an ED for issues they believe could have been managed by their primary care physician (PCP), if available. This is a striking finding in an international context, with Sweden having the lowest proportion of older individuals who regularly visit a PCP for their healthcare (124). There is a growing awareness of the positive impact a continuous relationship with a PCPs can have on reducing hospital admissions and ED utilization (125-127). Effective primary care characterized by continuity, accessibility and proactive management of chronic conditions can help prevent health crisis that leads to ED visits and subsequently hospitalizations (128). At the same time a lack of continuity between EDs and primary care can result in conflicting care plans as well as less effective management of chronic conditions (129). Robust primary care systems can coordinate care more effectively, streamline referrals and ensure that patients receive appropriate follow-up care which can contribute to lower admissions and ED utilizations for older adults (130, 131). Transitions to and from the ED for older adults are critical points where care continuity is vulnerable and effective communication between healthcare providers is essential to ensure a safe transition. Proper management of these transitions can reduce the risk of complications, prevent medication errors and decrease the likelihood of re-visits and readmissions. Figure 2 presents a schematic overview of the entry to and discharge from the ED.

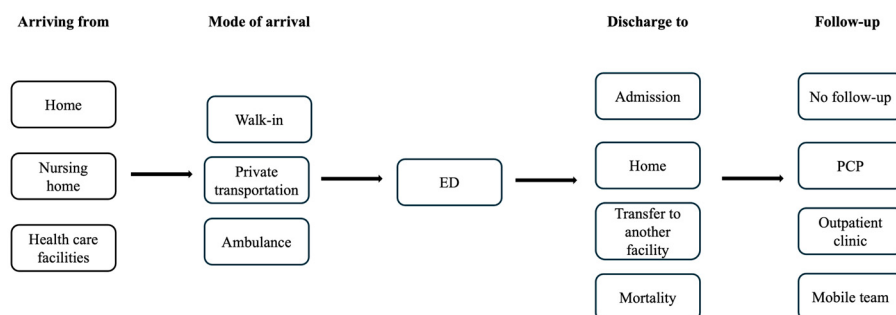


Figure 2. Schematic overview of the entry to and discharge from the ED

Risks for older adults associated with visits to the ED

Older adults visiting the ED are at high risk for adverse outcomes due to factors such as frailty, multimorbidity and atypical presentations. These vulnerabilities increase their susceptibility to complications such as medical errors, prolonged hospital stays and functional decline (3). While healthcare systems are increasingly organized around diagnosis-specific clinical pathways, the number of patients with complex conditions that do not conform to a single-diagnosis approach is rising. In fact, older adults with multimorbidity represent the fastest-growing population in acute care accounting for more than half of all hospitalizations. Delayed diagnoses are also more common among older adults in the ED and are associated with longer hospital stays and higher mortality (132). Table 1 illustrates some of the risks associated with visits to the ED for older adults (18, 132-139).

Table 1. Risks associated with ED visits for the elderly population 3. Vital signs and thresholds according to RETTS-A triage algorithm

Risks	Description
<i>Medications errors</i>	Polypharmacy is common among older adults, increasing the likelihood of drug interactions and dosing errors
<i>Misdiagnosis and delayed diagnosis</i>	Atypical presentations of illness in older adults can lead to misinterpretation of symptoms, resulting in delayed or incorrect treatment
<i>Delirium</i>	The stressful ED environment can trigger acute delirium, which may worsen overall outcome
<i>Falls and injuries</i>	The ED environment combined with frailty and mobility issues increases the risk of falls and injuries
<i>Infections</i>	Prolonged stays in the ED or hospital exposes older adults to a higher risk of infections
<i>Functional decline</i>	Extended periods of inactivity coupled with the stress of acute illness can lead to a decline in functional status and independence
<i>Iatrogenic complications</i>	Unnecessary interventions in the ED setting can lead to complications further compromising the health of older patients
<i>Thrombosis</i>	Prolonged immobilization during ED stays or hospitalizations increases the risk of venous thromboembolism
<i>Pressure ulcers</i>	Prolonged immobilization can lead to pressure ulcers and further complicate recovery
<i>Dehydration and malnutrition</i>	Older adults are particularly vulnerable to dehydration and malnutrition during prolonged ED stays or hospitalizations
<i>Exacerbation of chronic conditions</i>	The stress of acute illness combined with the interruption in routine care can lead to the worsening of existing chronic conditions

ED triage and vital signs in the geriatric population

Triage is the process of prioritizing patients based on the severity of their condition to ensure that those who need immediate care receive it as quickly as possible. In the ED, triage is used to manage patient flow efficiently, allocate limited resource effectively and reduce waiting times, thereby improving patient outcomes and ensuring that the most critically ill patients are treated first. In ED triage, vital signs play a crucial role in evaluating a patient's condition and determining the urgency of care. The primary vital signs assessed include heart rate (HR), systolic blood pressure (SBP), respiratory rate (RR), oxygen saturation (SpO₂), temperature, and level of consciousness (LOC). These measurements help detect critical conditions such as sepsis, shock, respiratory distress, or neurological impairment. Regular monitoring of vital signs enables healthcare professionals to identify early signs of deterioration and provide timely medical intervention (140).

Older patients with multimorbidity, polypharmacy and frailty often exhibit physiological changes that can alter standard vital sign cut-offs. As a result geriatric patients are at increased risk of having their conditions misinterpreted which can lead to under-triage and suboptimal care (141). Vital signs during triage are measured using standardized scales and established normative ranges, they serve as a universal language for conveying patient status and illness severity. When older adults present to the ED and undergo triage, critical clinical information is often incomplete, including missing baseline values or data on changes from baseline (142).

Under-triage occurs when the severity of a patient's illness is underestimated during the triage process, leading to an assignment of a lower priority care than is warranted. Triage for the geriatric population in the ED presents challenges and under-triage, are common among frail older adults (143, 144). Most triage scales still do not incorporate age, despite existing literature indicating that age is a significant predictor of mortality in the early stages following triage (145, 146).

Possible reasons for under-triage in elderly patients:

- Atypical presentations
- Multiple comorbidities
- Inappropriate interpretation of vital signs
- Cognitive impairment

Consequences of under-triage:

- Delayed diagnosis and treatment
- Higher risk of adverse outcomes
- Increased mortality
- Higher readmission rates

For older patients, personalized reference ranges should be considered with any deviations from these individualized norms serving as a potential indicators of underlying disease (147). During recent years there has been a growing interest in elderly-specific triage criteria and that adapted physiological parameters should be included in future triage models (148-152).

Systolic blood pressure and heart rate

Atherosclerosis and hypertension increase with age and can significantly affect cardiovascular dynamics in older adults (153). The presence of hypertension or atherosclerosis can complicate the interpretation of vital signs during triage, making it crucial for clinicians to consider the patient's underlying cardiovascular status when evaluating their triage data. Additionally, age-related declines in cardiovascular regulation can result in hypotension and clinical expressions such as recurrent falls, delirium, syncope and dizziness (154). Current sepsis guidelines typically define hypotension as a SBP below 90-100 mmHg, however in older adults and SBP above 100mmHg may not guarantee adequate tissue perfusion due to atherosclerosis (155).

Recent findings indicate that the standard hypotension threshold does not provide a clinical meaningful basis for risk stratification in older ED patients with suspected infection (156). Age-related changes such as hypertension and arrhythmias alongside with polypharmacy can influence both SBP and HR during triage. Along with physiological changes, medications such as beta-blockers or antihypertensives can lower HR and SBP, consequently clinicians must interpret these measurements with consideration of the patient's age and medication regimen (147, 157).

Oxygen saturation

Assessing SpO₂ in elderly patients during triage is challenging due to age-related physiological changes and medical conditions. Poor peripheral perfusion from vascular disease, hypotension, or cold extremities can cause inaccurate pulse oximetry readings, while reduced skin elasticity may affect sensor placement. Chronic respiratory diseases like COPD result in lower baseline SpO₂, complicating the detection of acute deterioration (158-160). Conditions such as anaemia and heart failure can impair oxygen delivery without affecting SpO₂ levels, and silent hypoxia, seen in infections like COVID-19 or sepsis, may lead to under-triage in asymptomatic patients (161, 162). To improve accuracy, alternative measurement sites like the earlobe or forehead and repeated assessments should be used alongside a comprehensive clinical evaluation.

Respiratory rate

Several age-related changes in the respiratory system can affect the RR during triage. Diminished respiratory muscle strength, stiffening of the rib cage, and a weakened ventilatory response to hypoxia and hypercapnia may lead to atypical respiratory patterns, causing the measured RR to inadequately reflect the true severity of respiratory distress (163). Additionally, common conditions among older adults such as COPD or heart failure can further influence respiratory function. When evaluating the RR in older patients during triage, it is essential to consider the overall clinical context and individual physiological changes.

Temperature

Older adults often exhibit altered thermoregulation which may result in lower baseline temperatures and a diminished febrile response during infections (164). Due to diminished thermoregulatory capacity in older adults even a slight deviation from their baseline temperature can be clinically significant. Since these patients often have a reduced ability to mount a fever response, a minor increase in temperature may signal a underlying disorder (165).

Level of consciousness / mental status

Assessing LOC and mental status is a critical component of ED triage, especially for elderly patients who are at higher risk of delirium, cognitive impairment and neurological conditions. In the ED standardized tools are used to assess mental status and LOC. Glasgow Coma Scale (GCS) is one of the most widely used methods, evaluating eye, verbal and motor responses with scores ranging from 3 (coma) to 15 (fully alert) (166). Another commonly used system is the AVPU scale (alert, verbal, pain, unresponsive) which provides a rapid classification of consciousness level (167). In some countries, the Reaction Level Scale (RLS-85) is widely used, particularly in Scandinavian regions, regarding responsiveness from 1 (fully alert) to 8 (no reaction) (168).

Cognitive impairment is prevalent among older adults, with approximately 25% of elderly ED patients showing signs of cognitive decline. This impairment indicates increased vulnerability and is associated with higher mortality rates during an ED visit (169).

Delirium

Delirium is an acute, fluctuating disturbance in attention and cognition, commonly affecting older adults in emergency settings. Its prevalence among hospitalized elderly patients varies, with studies indicating rates ranging from approximately 20% to 40% (170, 171). Its prevalence in the ED varies, with studies indicating rates ranging from approximately 7% to 20%. Early detection is crucial for effective management and improved outcomes.

The 4 'A's Test (4AT) is a rapid screening tool designed for the swift detection of delirium without requiring special training. It evaluates four key parameters: alertness, abbreviated mental test, attention (months backwards), and acute change or fluctuating course. Scoring ranges from 0 to 12, with a score of 4 or more suggesting possible delirium. Implementing the 4AT in emergency settings facilitates timely identification of delirium, enabling prompt intervention and potentially reducing adverse outcomes in older adults (172). In addition to the 4AT there are several other validated tools commonly used to screen for delirium in clinical settings. For example, Confusion Assessment Method (CAM) is a widely used instrument that identifies delirium based on four key features: acute onset and fluctuating course, inattention, disorganized thinking, and altered LOC. The CAM has a high sensitivity and specificity and is suitable for use by trained healthcare professionals (173, 174).

Delirium is linked to increased morbidity and mortality in this population yet remains frequently overlooked (16). The absence of systematic screening for delirium in the ED has negative implications and unrecognized delirium in the ED is often missed during the hospital stay as well (147, 175). Research indicates that it is common for ED patients with delirium to be sent home despite their impaired cognition. These patients frequently make re-visits to the ED because they often fail to fully understand their diagnosis or discharge instruction (176). Impaired cognition in older adults can complicate the assessment during triage and may hinder effective communication and evaluation of a patient's physiological status. Studies suggest that higher thresholds for mental status should be used during triage for older adults (149).

Non-specific complaints

Specific complaints are well-defined symptoms that indicate a particular diagnosis, such as chest pain or fever. In contrast NSC are vague, general symptoms that do not clearly indicate an underlying condition. NSC are typically described as general decline in health, with terms like weakness, fatigue, confusion or simply "feeling unwell" frequently used. Up to 20% of elderly patients in the ED presents with NSC, and studies indicate that half of these patients have a serious underlying condition (8, 110). Despite often exhibiting normal vital signs, patients with NSC are frequently under-triaged, even though they experience

higher rates of hospital admission and mortality compared to those with specific complaints (3, 8, 177). While clear protocols exist to guide decision-making for specific complaints, standard protocols often do not apply to NSC, making them one of the most challenging conditions for ED physicians (178). Despite several studies highlighting the increased risk associated with NSC, these presentations are still not adequately incorporated into standard triage systems leaving a gap between current knowledge and clinical practice.

NSC can be grouped into five categories: (1) somatic concerns, including general weakness, malaise, altered nutritional intake, or unexplained weight loss; (2) increased care needs, such as new dependence on assistance, the need for a change in living arrangements, or initiation of around-the-clock care; (3) cognitive changes, including disorientation, behavioural alterations, or sudden cognitive decline; (4) functional deterioration, particularly reduced mobility; and (5) unexplained falls not attributable to external causes (179).

Atypical presentations in the elderly

Elderly patients often present to the ED with atypical symptoms that can mask serious underlying conditions. Instead of the classic, textbook presentations seen in younger individuals, older adults may exhibit subtle or non-specific signs that complicate the diagnostic process. For example, rather than reporting chest pain during a myocardial infarction, an elderly patient might present with shortness of breath, fatigue, or even confusion. Similarly, infections such as urinary tract infections might not come with a fever or dysuria but instead manifest as sudden changes in mental status or increased falls. These atypical presentations can delay diagnosis and treatment, as they do not immediately signal a critical condition (180).

Multiple factors contribute to these atypical presentations. Aging is associated with a diminished physiological response to stress and illness, meaning that the body's usual signs of inflammation or pain may be blunted (181). Additionally, comorbidities and polypharmacy can further obscure the clinical picture. For instance, medications that alter HR or mask fever can make it more difficult to recognize an underlying infection or cardiovascular event (182).

Due to these complexities, healthcare providers in the ED must maintain a high index of suspicion and conduct comprehensive assessments when evaluating older adults. Incorporating detailed history-taking, thorough physical examinations, and appropriate use of diagnostic tests is essential. Being aware of these atypical presentations not only helps in timely diagnosis but also improves patient outcomes by facilitating early and targeted interventions. Atypical presentations in elderly patients in the ED pose significant challenges. Understanding these nuances is critical for emergency clinicians to avoid missed diagnoses and ensure that older patients receive prompt and effective care (183, 184).

Geriatric trauma

Geriatric trauma refers to injuries sustained by individuals aged 65 and older. In ED settings, these patients present unique challenges due to age-related physiological changes, comorbidities, and increased frailty, leading to higher morbidity and mortality rates compared to younger populations. Falls are the most prevalent cause of injury among older adults, often resulting in fractures, head injuries, and significant functional decline. The consequences of trauma in geriatric patients are profound. They face increased mortality rates, prolonged hospitalizations, and a higher likelihood of losing independence post-injury. These outcomes underscore the need for specialized care strategies to address the unique vulnerabilities of older trauma patients. (185, 186).

Under-triage occurs when severely injured patients are not identified as needing higher levels of care, leading to inadequate treatment. Older adults are particularly susceptible to under-triage due to atypical presentations and the use of standard triage criteria that may not account for age-related physiological differences (187, 188). Enhancing the care of geriatric trauma patients involves implementing several key strategies. Developing age-specific triage protocols that account for the unique physiological responses of older adults can improve the accuracy of triage decisions (149, 189). Incorporating geriatric specialists into trauma teams ensures comprehensive assessments and tailored interventions, addressing the complex needs of these patients. Providing ED staff with specialized training on the complexities of geriatric trauma can improve recognition and management (190).

Elder abuse

Elder abuse involves harmful or distressing actions or neglect directed at older individuals, often by trusted caregivers or family members. This maltreatment can take various forms, including physical, emotional, sexual, or financial abuse, as well as neglect (191). In ED settings, identifying elder abuse is particularly challenging due to its often subtle signs and the vulnerability of the affected population.

Elder abuse is alarmingly common, affecting approximately 10% of community-dwelling older adults annually, with even higher rates in institutional settings. Victims face increased risks of mortality, nursing home placement, exacerbation of chronic illnesses, and depression. Despite its prevalence, elder mistreatment is frequently under-recognized and underreported (192, 193). ED serve as critical points for identifying elder abuse, as victims often seek medical attention for related injuries or health issues. Detection rates remain low due to factors such as time constraints, lack of training, and the subtlety of abuse indicators (194). A study revealed that 7% of cognitively intact older ED patients reported experiencing physical or psychological mistreatment in the past year, a figure likely underestimated due to underreporting and unrecognized cases (195).

Challenges in detection of elder abuse in the ED:

- Atypical presentation – Elderly patients may present with NSC such as confusion or frequent falls which can obscure underlying abuse
- Communication difficulties – Cognitive impairments or fear of retaliation may prevent victims from disclosing abuse
- Time constraints – Busy ED environments may limit the thoroughness of assessments necessary to detect abuse

The manifestations of elder abuse can be subtle and easily overlooked, especially when they present as NSC or atypical symptoms. A decline in functional or mental status, reduced oral intake, incontinence, or frequent falls may initially appear as common geriatric syndromes but could also signal underlying abuse. The overlap between atypical presentations and signs of abuse necessitates a high index of suspicion among healthcare providers. Emergency clinicians should consider the possibility of mistreatment when evaluating older patients with vague or unexplained symptoms (196-198).

Enhancing the identification and management of elder abuse in ED settings necessitates a multifaceted approach. First and foremost, it is crucial to provide ED staff with comprehensive training to recognize signs of abuse and understand reporting protocols. Implementing validated screening tools tailored to the ED environment can systematically aid in identifying abuse cases. Furthermore, fostering collaboration among social workers, geriatric specialists, and legal authorities ensures comprehensive care and appropriate interventions for suspected abuse cases. By addressing these challenges and implementing targeted strategies, the ED can play a pivotal role in identifying and mitigating elder abuse, thereby improving outcomes for this vulnerable population (192, 199).

Strategies to reduce ED visits and admissions for older adults

There is a broad agreement that traditional, disease-specific emergency care models do not adequately address the complex medical, functional and social needs of older patients. Effectively managing both acute and chronic conditions in this population requires care models that prioritize continuity, comprehensive assessment and integrated services (3). The ED is a critical care resource for older adults, yet it is also linked to an elevated risk of morbidity and mortality. Various strategies and interventions have been proposed and implemented to reduce avoidable ED visits among this population. Interventions to reduce ED visits and admissions typically focus on improving continuity of care, enhancing care coordination and providing targeted support for high-risk patients (130, 131, 200-204).

- Enhanced primary care – Enhancing access to and continuity of primary care is essential for early intervention and effective management of chronic conditions, thereby reducing the likelihood of emergency situations. Studies have shown that individuals with consistent primary care relationships are less likely to utilize the ED for non-emergent issues (205).
- Case management – Implementing case management programs that monitor and support frequent ED users can effectively reduce ED visits among older adults. These programs involve coordinated care strategies tailored to individual patient needs, aiming to improve health outcomes and decrease avoidable ED utilization. Embedding case managers within the ED to connect older adults to community services has been associated with improved patient outcomes. Additionally, patient-centred case management interventions have been shown to effectively reduce ED visits and hospitalizations, leading to better resource utilization (206).
- Home-based services – Implementing home-based services, such as mobile healthcare teams and hospital-at-home programs, allows for the delivery of acute care directly in patient's homes with the aim to reduce the need for ED visits and hospital admissions (207, 208).
- Integrated care models – Integrated care models and transitional care are essential for improving health outcomes among older adults, particularly during transitions from hospital to home. These approaches focus on coordinated, continuous care, aiming to reduce hospital readmissions and ED visits (209, 210).

Even though several interventions have been implemented with the intention to reduce ED visits the most clinically beneficial and cost-effective strategy remains uncertain. Given the significant resources required for implementation, current evidence indicate that none of the interventions examined are likely to generate significant overall cost savings for the healthcare system and further studies are needed to best meet the needs of older adults (200, 211, 212).

Mobile teams

Mobile teams composed of interdisciplinary expertise have been proposed as an effective approach to delivering acute care in the patient's home, potentially reducing the need for ED visits and hospital admissions. These multidisciplinary teams are primarily aimed at very sick individuals with complex care needs, but home visits may also be advantageous for elderly patients by providing early interventions that could indirectly prevent the need for ED care. The current evidence remains inconclusive with studies reporting positive, negative or mixed outcomes regarding their impact on care utilization. Some studies have shown that mobile teams can enhance patient's quality of life and sense of safety (213, 214).

Other studies have reported mixed results, indicating that while mobile teams may not consistently reduce ED visits, they can improve in-hospital stays and lower overall healthcare consumption when appropriately targeted (208). Additionally, certain studies have demonstrated that mobile teams can reduce ED utilization among patients with complex needs and frequent ED visits (215). It remains unclear whether such home care services are best provided by primary care or by specialized mobile teams operating independently.

A Swedish overview article from 2021 concluded that the introduction of mobile teams leads to a redistribution of resources, potentially resulting in both cost savings and increased expenses in different parts of the healthcare systems. Further research is needed to develop cost-effective, high quality care models that optimize clinical outcomes and resource use (216).

Integrated care planning

Integrated or coordinated care planning has been proposed as another effective strategy to reduce ED visits and hospitalization. This approach involves a structured process in which multiple healthcare providers, often from different sectors, collaborate to develop a tailored care plan for each patient. The primary objective is to ensure that all necessary care and support services are well-coordinated, thereby improving continuity of care, patient safety and overall quality of life. In practice integrated care involves various sectors, including primary care, specialist care, home care service and social support systems. Integrated care emphasizes the proactive management of chronic conditions, early detection of health issues and comprehensive coordination of medical and social services (129, 217).

The WHO highlights the importance of integrating health and social services to ensure that adults receive seamless, coordinated care across different levels of service according to their individual needs. By sharing information and collaborative care planning, healthcare providers can identify potential risks early, prevent complications and reduce health care utilization (218-220). A well-structured integrated care plan not only addresses medical needs but also considers a patient's preferences, functional abilities and life circumstances (221).

Beyond managing chronic conditions, older adults often face additional challenges such as functional disabilities, communications difficulties and limited social support. These factors can negatively impact the quality of care received in the ED, hinder smooth transitions to home or other care facilities and increase the risk of hospitalizations and revisits to the ED. Ensuring effective communication and cooperation between primary care, hospital services, home care and social services is crucial for this vulnerable population (222, 223).

Research on the impact of integrated care on hospitalization and ED visits has yield mixed results. A systematic review examining ED interventions for older adults found inconsistent outcomes regarding the effectiveness of integrated care strategies. While certain interventions, such as discharge planning and case management showed some positive effects on functional status, they did not consistently reduce hospitalization or revisits to the ED. Other studies have suggested that interventions bridging care before and after ED discharge may be associated with improved outcomes (222).

Other review studies have demonstrated that integrated care models can have positive effects on admission rates, in-hospital LOS, readmissions and patient satisfaction, although they appear to have no significant impact on overall mortality. These findings indicate that while integrated care show promising trends in improving certain health outcomes, further research is needed to fully understand its long-term effects and to refine strategies for achieving consistent reduction in ED visits and hospitalizations (224, 225). By linking primary care with community resources, social support, and, when necessary, palliative care, integrated care models ensure that all aspects of a patient's health are managed comprehensively. This holistic approach reduces the likelihood of emergency care resulting from unmet medical or social needs, thereby promoting better health outcomes and enhancing patient well-being (226-229).

While integrated care planning holds great potential for reducing ED visits and hospitalizations among older adults, the current evidence remains mixed. Further research is needed to identify the most effective strategies, components, and implementation models to maximize the benefits of integrated care. Establishing evidence-based approaches will be essential for achieving sustained reductions in emergency healthcare utilization and improving patient outcomes.

Discharge planning and transitional care

Transitional care involves coordinated actions to maintain continuity of healthcare as patients move between different locations or levels of care. Older adults, often managing multiple chronic conditions, frequently transition across various healthcare settings, making them particularly vulnerable during these periods. Unplanned transitions, such as those resulting from acute illnesses leading to ED visits, present significant challenges. Implementing effective transitional care strategies is crucial to prevent medication errors, ensure timely follow-up care, and avoid unnecessary ED visits (230).

The transition from hospital to home is particularly challenging, as patients and families often become responsible for coordinating care. Hospital discharges can be complex and lack standardization, increasing the risk of readmissions and adverse drug events. Factors influencing these risks include characteristics and activities of the health system, patient, and clinician. For instance, discharge instructions may vary between providers or may not

be tailored to a patient's health literacy or current health status. Prior studies have shown that early discharge preparation can significantly decrease hospital LOS, readmission risk, and mortality risk (231).

Implementing effective transitional care interventions has been associated with reduced hospital readmissions, improved patient satisfaction, and decreased healthcare costs. Clear communication with patients is associated with better patient-reported outcomes and reduced healthcare utilization. Prioritizing comprehensive post-discharge planning and transitional care is vital in geriatric emergency care. Such efforts not only enhance the quality of care for older adults but also contribute to more efficient healthcare delivery systems (17, 232, 233).

Geriatric Emergency Department

Geriatric Emergency Department (GED) began to form in the early 2000s as healthcare systems recognized the unique challenges posed by aging populations. In 2008 ACEP, the Society for Academic Emergency Medicine (SAEM) and the American Geriatric Society (AGS) formalized the GED concept.

ACEP has since developed criteria's for GED accreditation on three different levels and the following categories are of most importance according to the ACEP Geriatric Emergency Department Accreditation (GEDA) in 2023 (67, 234, 235):

- Staffing – The ED should have physicians and nurses on staff with geriatric knowledge and how to care for geriatric patients in the ED.
- Education - Focused on geriatric-specific syndromes and concept (atypical presentations, age-related changes, end of life care, dementia, delirium, transitions of care, trauma in older adults, cardiac arrest care for the geriatric patient, polypharmacy).
- Care processes, guidelines and procedures – Guidelines for minimizing urinary catheter, fasting and physical restraint minimization. Standardized screening for delirium, standardized assessment of function and functional decline, screening for elder abuse, guidelines to minimize inappropriate medications, guideline for pain control in elder patients, standardized discharge guideline for patients discharged home and clear follow-up plan, guideline for notification to primary care.
- Quality improvement - Well-thought-out system for how to monitor and ensure increase quality related to implemented programs

- Outcome measures - Percentage of geriatric patients who have a longer LOS than ≥ 4 hours at the ED after admission decision, number of patients screened for delirium and elder abuse, number of older adults with repeated ED visits and admissions.
- Equipment and supplies - Access to walking aids, non-slip socks, pressure-ulcer reducing mattresses, blanket warmer and hearing assist devices.
- Physical environment - easy access to food and drink, two chairs per patient bed to promote visitors and the possibility of sitting, large analog clock in each patient room, enhanced lighting, availability of raised toilet seats

GED have rapidly emerged as a care model designed to meet the unique care need of older adults at the ED. Implementing some of the criteria's such as screening, assessment, care processes and safe discharge for older adults at the ED are a way to enhance the quality of care for older adults at the ED regardless of available resources or physical environment (236).

Competence and geriatric approach in emergency care

Providing safe and effective emergency care for older adults requires more than traditional acute care expertise. It demands a set of geriatric-specific competencies tailored to the complex and multifaceted presentations of this population. Older adults frequently arrive at the ED with non-specific symptoms, atypical disease manifestations, polypharmacy, and concurrent medical, cognitive, and social issues. These factors complicate diagnostic and treatment processes, increasing the risk of under-triage, delayed diagnoses, and fragmented care (3, 143).

Despite these challenges, formal training in geriatrics remains limited in emergency medicine curricula worldwide (237). Evidence suggests that many emergency physicians feel underprepared to address critical geriatric concerns, including cognitive impairment, frailty, and end-of-life care (238). A 2010 expert consensus identified essential geriatric competencies for emergency medicine residency programs, yet these have not been consistently adopted (239). This educational gap is particularly concerning as older adults represent a growing share of ED visits and are disproportionately affected by adverse outcomes.

Traditional emergency medicine training emphasizes time-sensitive, disease-specific protocols, which often fail to address the nuanced and multimorbid nature of geriatric presentations. Without adequate geriatric training, clinicians may miss subtle signs of serious illness, overlook red flags, or be unable to tailor care to the patient's overall goals, functional status, or social context. Improving care quality therefore requires a paradigm

shift, geriatric competence must be embedded within the ED team rather than relying solely on specialist consultation (240, 241).

While geriatricians bring essential expertise, emergency physicians and nurses are uniquely positioned to make real-time clinical decisions, coordinate ED resources, and initiate timely investigations. A strong geriatric approach hinges on equipping the entire ED team with the knowledge and tools to recognize and manage conditions like frailty, delirium, cognitive decline, and functional impairment, factors that significantly influence both acute management and safe discharge (10, 242).

Targeted geriatric education has been shown to enhance emergency clinicians' ability to identify vulnerable patients early, apply validated screening tools, and adjust investigations and treatment accordingly. Training in geriatric syndromes and clinical decision-making under uncertainty improves diagnostic accuracy, reduces unnecessary admissions, and supports more appropriate resource use (243). Moreover, clinicians with geriatric competence are better equipped to engage in shared decision-making and develop care plans aligned with patient values, thereby improving transitions of care.

The movement toward age-friendly EDs and frameworks such as the "4Ms": Mentation, Mobility, Medications, and What Matters Most, reflects a broader shift toward person-centred care in acute settings (244). However, these strategies must be fully integrated into daily ED workflows to be effective, rather than siloed within specialist roles.

In conclusion, incorporating geriatric education into emergency medicine training is a practical, scalable approach to meeting the needs of an aging population. By strengthening geriatric competence among ED teams, healthcare systems can enhance early recognition of high-risk patients, streamline clinical pathways, and ultimately improve outcomes in geriatric emergency care.

Research on health data

Advances in digital technology, alongside progress in medical science and technology are driving the increased collection and digital storage of individual health data. The development of digital health data refers to electronic information related to an individual's or groups' health, care or living conditions. This term also encompasses administrative data on healthcare resources, costs and quality. Health data specifically refers to information that is digitally stored in various healthcare databases and registries (245).

Research on health data offers significant advantages alongside notable challenges. It provides large-scale insights by enabling researchers to identify population-level trends and patterns that can inform public health policies and clinical practices. Health data deliver real-world evidence on patient outcomes, treatment effectiveness and healthcare utilization.

The availability of historical data facilitates longitudinal studies to track health outcomes and disease progression over time, thereby supporting more informed decision-making by healthcare providers and policymakers and ultimately enhancing patient care and resource allocation. Using existing health data is often more cost-effective than primary data collection, reducing both research expenses and time (246-248).

On the other hand, the use of health data raises significant privacy and security concerns as breaches can compromise sensitive patient information. Data quality and completeness may also be problematic, with potential issues such as inaccuracies or inconsistent recording that can undermine the reliability and validity of research findings. Data collected in routine clinical practice can be subject to bias and may not be representative of the broader population, which limits the generalizability of the results. Integration challenges may also arise when merging data from different sources due to variations in data formats, standards and coding practices. Researchers must navigate complex ethical and legal frameworks when accessing and using health data (248, 249).

Balancing these advantages and challenges is crucial to maximizing the potential of health data research while safeguarding patient rights and ensuring robust, reliable outcomes.

Challenges in researching geriatric emergency medicine

Research in geriatric emergency medicine presents challenges due to the interdisciplinary nature of the field and the complexity of the patient population. As a relatively new and evolving area, it bridges multiple domains including geriatrics, emergency medicine, primary care, and prehospital care. This intersection of specialties offers important opportunities for collaboration but also introduces methodological and practical difficulties (250).

One of the primary challenges lies in the clinical heterogeneity of older patients. Standardized protocols often fall short in capturing the nuanced presentation and needs of this group. Older adults are historically underrepresented in clinical trials, limiting the external validity of many emergency care studies for this population (251). Geriatric indicators such as frailty, functional status, and cognitive impairment are often under-reported or inconsistently measured. Standardized definitions and validated tools are still being developed and refined for use in acute care settings (252).

Another major difficulty is coordinating research across care settings and disciplines. Differences in terminology, clinical priorities, and organizational structures between geriatrics and emergency medicine can hinder both study design and implementation. For

instance, the goals of emergency medicine often focus on rapid triage and disposition, while geriatrics emphasizes comprehensive assessment and long-term outcomes. Integrating these perspectives requires careful planning and strong collaborative frameworks (253).

Publishing in the field of geriatric emergency medicine poses additional barriers. Because the field bridges multiple specialties, research may not neatly fit the scope of traditional journals. Studies may be seen as too geriatric for emergency medicine journals or too emergency-focused for geriatric journals, making it difficult to find a suitable venue for publication. Additionally, reviewers may question the generalizability of findings due to the heterogeneity of the study population or the perceived complexity of implementing geriatric-focused interventions in emergency departments. Furthermore, despite growing recognition of the need for geriatric emergency care, high-impact journals still publish relatively few studies on this topic (211). This scarcity of outlets can discourage researchers and slow the dissemination of important findings. Methodological limitations, such as underpowered studies or lack of standardized geriatric variables, may further reduce acceptance rates.

To improve the likelihood of publication, researchers are encouraged to clearly articulate the clinical relevance of their work, frame their studies in a way that resonates across disciplines, and incorporate validated measures of frailty, function, and cognition where possible. Increasingly, journals like *Academic Emergency Medicine*, *BMC Geriatrics*, and *Journal of the American Geriatrics Society* are recognizing the value of this work, signalling a positive shift in the field.

Despite these barriers, research in geriatric emergency medicine is urgently needed. With aging populations worldwide, older adults constitute a growing proportion of ED visits, and their care requires evidence-informed, age-appropriate strategies. Research in this area holds the potential to improve quality of care, reduce adverse outcomes, and support better resource utilization.

Aims

The overall aim of this thesis was to characterize older adults presenting to the ED and identify key risk factors associated with prolonged LOS, hospital admission, and short-term mortality. In doing so, the thesis also aimed to provide evidence-based proposals for improving emergency care and outcomes for this population.

This work responds to a growing need for research in the evolving field of geriatric emergency medicine, where traditional models of emergency care are often ill-equipped to address the complex, multimorbid, and atypical presentations common among older patients. By systematically examining system-level processes, community interventions, clinical presentations, and physiological predictors, this thesis seeks to contribute new insights into the development of more age-adapted, integrated, and person-centred emergency care for older adults.

The specific aims for each part are described in detail below:

PART I: Determine if patients are more frequently denied ED evaluation at times of high in-hospital bed occupancy. Such finding would be concerning as it may indicate that triage nurses are less likely to refer patients during periods of high occupancy.

PART II: Assess whether a mobile team intervention led to positive outcomes by reducing ED visits and hospitalizations among older adults receiving MHC.

PART III: Compare older adults with NSC at the ED with patients with specific chief-complaints such as dyspnea, chest pain and abdominal pain regarding admission rate and 30-day mortality.

PART IV: Explore the relationship between vital signs, chief complaints and 7-day mortality in geriatric patients visiting the ED, with the goal of improving understanding of how vital signs influence outcomes in older adults. The ultimate aim was to enhance triage protocols to improve patient safety and reduce adverse events in this vulnerable population.

Method

Description of the study setting

There have been demographic changes alongside with healthcare changes in Sweden over recent decades. Contrasting with the aging population, Sweden has experienced a marked reduction in hospital bed availability and is one of the countries in the European Union with the lowest number of available hospital beds per capita (254). The annual hospital stay in Sweden has decreased by 35% the last decades, corresponding to almost 10 000 fewer hospital beds. During the same period the number of hospital admissions has decreased by 5%. The reduction in hospital beds has primarily been achieved by shortening the average LOS and the largest decrease has been observed among the oldest patients (255). The simultaneous increase in the elderly population and decrease in hospital beds present challenges for the healthcare system. An aging population requires more medical care and the reduction in hospital beds may lead to increased pressure on other healthcare services such as primary care and EDs, potentially affecting patient care quality and accessibility.

In recent years, Sweden has experienced a steady rise in ED visits, with roughly one in three visits resulting in hospital admission. In 2023, Sweden recorded 1.8 million ED visits, a 2% increase from the previous year. The average ED LOS was 4 hours and 17 minutes, with patients typically waiting around 1 hour for their initial physician assessment. Notably, older adults experienced the longest LOS compared to younger patients. Furthermore, Region Skåne and Region Halland were among the regions with the longest ED LOS from arrival to discharge (103).

Region Skåne

Region Skåne is a geographic region located in the southern part of Sweden and had population of 1,42 million people in 2023. When the first study was conducted, the population was 1,25 million people and the proportion of elderly has increased since then. The number of individuals over 80 years is expected to rise by 42% in the coming years (256). The region consists of both university hospitals, emergency hospitals and local hospitals. Helsingborg hospital is one of four specialized hospitals in the region providing emergency care. The other three emergency hospitals in the region are Skåne University

hospital in Malmö, Skåne University hospital in Lund and Kristianstad Hospital. Helsingborg hospital has a 420 in-hospital beds and around 65 000 ED visits each year. Helsingborg has approximately 150 000 residents and the proportion of elderly individuals is 18,7 %, which is slightly lower than the national average.

Region Halland

Region Halland is a geographic region located in the southwestern part of Sweden, with a population of approximately 340 000 residents in 2024. In the region about 23% of the population are ≥ 65 years, indicating a slightly higher proportion compared to the national average (20,6%) (257). It comprises several municipalities including, Halmstad, Varberg, Laholm, Kungsbacka, Falkenberg and Hylte which collectively contribute to the health care demands and needs in the area. The region has two major hospitals with EDs, situated in Halmstad and Varberg. Hallands Hospital Halmstad is the largest hospital in the region with 17 in-patient units and a total of 269 somatic hospital beds, including 7 intensive care unit beds. Whereas Hallands Hospital Varberg has 17 in-patient units and a total of 225 somatic hospital beds, including 6 intensive care unit beds (258). Over the past decade, the number of hospital beds in the region has declined, making Region Halland currently one of the regions in Sweden with the fewest hospital beds per capita (255).

The region has 46 primary healthcare centres (PHC) where 23 of the PHC centres are publicly funded and 23 PHC centres are run by private care providers. In recent years the number of contacts with PHC has increased by 8 %, and the number of home-visits made by PCP has increased by 20 % according to data provided by Region Halland.

A majority of the elderly population in Sweden lives in regular housing, 12% of the women and 8,5% of the men receives help in their home for their daily activities, and 6% of the woman and 4% of the men live in nursing homes (259). Older adults, still living in regular housing, can apply for municipality home care (MHC) when their health deteriorate, or when they develop a need for closer contact with health care services. MHC can include managing medications, monitoring and regulating chronic conditions and establish care plans by the supervisions of PCP. Usually MHC works very well, but when an older adult suddenly deteriorates it can be difficult to get in contact with the responsible physician in PHC this often leads to unplanned visits to the ED.

During 2010-2014 a national initiative called “Better life for the sick elderly” was initiated where the government made annual agreements with Sweden’s municipalities and counties. The goal was to integrate care and services for the most seriously ill elderly (260). As a part of this initiative, a mobile team intervention for patients in MHC was implemented in the region in May 2015. The purpose of this physician assisted mobile team was to support nurses in MHC to ensure that frail elderly patients could be cared for safely at the appropriate care level and reduce avoidable ED-visits and admissions. Physicians were

available for consultations and home visits at a short notice if an elderly person deteriorated at home. The goal was also to improve availability and health care for older adults and to strengthen the collaboration between MHC, primary care and the hospitals in the region.

Different initiatives in Region Halland on coordinating care for patients with high risk for admission and readmission:

- Mobile team intervention for patients in MHC
- Individual care planning
- Older adults with multimorbidity
- Safe discharge

The initiative to strengthen and coordinate the care for the elderly population has continued and in 2023 an agreement between the state and the SALAR were met regarding a transformation of Swedish healthcare with the goal to ensure that patients receive good and coordinated care that enhances their health (261). As a part of this agreement Region Halland has now continued with targeted PCP home-visits to improve the health of the elderly and to reduce the number of avoidable hospital admissions.

Various initiative has been launched in Sweden in recent years to address the aging population and challenges for the healthcare system. While these initiatives may have different objectives, three focus areas can be identified:

- Reducing ED-visits: Focus on preventing avoidable visits by strengthening primary care and providing better access to community-based care options
- Minimizing hospital admissions: Focus on managing chronic conditions, early intervention and offering outpatient or home-based alternatives to hospitalization
- Preventing readmissions: Focus on discharge planning, follow-up care and patient education to ensure a safe transition from hospital to home and avoid complications

Initial assessment at the ED

In Sweden patients who walk-in, or arrive by private transportation or ambulance, to the ED are registered, triaged and prioritized in the following order:

- Initial assessment / measure of vital signs: RR, HR, SpO₂, SBP, temperature and LOC
- Chief complaint: patient reported symptoms
- Triage level: based on the combination of chief complaint and vital signs
- Decision: triage level and urgency determine if the patient should receive immediate treatment or waiting time for diagnostic tests and evaluation
- Outcome: admission, transfer to another facility, discharge with or without follow-up plan

Table 2. Triage levels in RETTS-A triage algorithm

Colour	Description
Red	Immediate life-threatening condition
Orange	Severe condition but not immediate
Yellow	Moderate severity
Green	Minor issues, stable condition
Blue	Non-urgent, outpatient care

Initial assessment, chief complaint and triage level are based on validated triage systems. In Sweden the most used triage system is Rapid Emergency Triage and Treatment System-Adult (RETTS-A) and it was implemented in 2013 (262).

Table 3. Vital signs and thresholds according to RETTS-A triage algorithm

	Red	Orange	Yellow	Green	Blue
Airway	Airway obstruction Stridor	Threatened airway		Clear airway	Not in need of triage
Breathing					
RR	RR > 30/min RR <8/min	RR >25/min		RR 8-25/min	
SpO ₂	SpO ₂ with O ₂ <90%	SpO ₂ without O ₂ <90%	SpO ₂ without O ₂ 90-95%	SpO ₂ without O ₂ >95%	
Circulation					
HR	HR >130/min	HR >120/min HR <40/min	HR >110/min HR <50/min	HR 51-109/min	
SBP	SBP <90mmHg				
Disability	Unconscious, seizures	Somnolence	Disoriented	Alert	
GCS	GCS <8	GCS 8-12			
RLS	RLS >3	RLS 2-3			
Exposure					
Temperature		>41°C, <35°C	>38,5°C	35-38,5°C	

Note: RR = respiratory rate, SpO₂ = peripheral oxygen saturation, HR = heart rate, SBP = Systolic blood pressure, GCS = Glasgow Coma Scale, RLS = Reaction Level Scale

Description of the study

The primary objective of this doctoral thesis was to identify and analyse the factors that influence ED visits, admission rates and mortality among geriatric patients in emergency care settings. Understanding these factors is crucial for optimizing healthcare delivery and improving outcomes for this vulnerable population, particularly given the increasing proportion of older adults requiring acute medical attention.

This thesis is comprised of four papers, each addressing different aspects of emergency care, with primary focus on elderly patients. Paper I was conducted as retrospective cohort study on administrative data from the ED at Helsingborg hospital in RS. This study provides information regarding primary triage permeability in the ED and if referrals from the ED increases during times of high in-hospital bed occupancy.

In contrast, paper II was designed as a retrospective pre-post intervention study to evaluate whether a mobile team intervention could reduce ED visits and hospital admissions among older adults receiving MHC. By analysing data from a defined time period, the study aimed to assess the intervention's effectiveness in decreasing in-hospital utilization for older adults.

Paper III and IV were conducted as retrospective observational studies, utilizing existing patient data to examine patterns and associations related to geriatric care in the ED. These studies provide insights into how specific demographic and clinical factors contribute to hospital admissions and mortality outcomes in elderly patients.

Together these studies offer a comprehensive analysis of factors influencing outcomes for elderly patients in emergency care and provides evidence that may be used in clinical practice to improve the care for older adults and the use of healthcare resources.

Definitions of study variables

Adverse events: was defined as ED-visits, admission to the hospital or mortality.

Comorbidity: were assessed using CCI. Based on the CCI score, comorbidities were categorized as mild (score 1–2), moderate (score 3–4), or severe (score ≥ 5) (38, 263). CCI was used in paper II and IV.

In Paper III, comorbidity was assessed using ICD-10 codes. Diagnoses were grouped into clinically relevant categories: hypertension, ischemic heart disease, atrial fibrillation, heart failure, cerebrovascular insult, diabetes mellitus, COPD, musculoskeletal pain, psychiatric disorders, and tumours (see table 4). Patients without any of these diagnoses were classified as previously healthy. To quantify comorbidity, the number of diagnostic categories per patient was counted. Patients were then categorized into three groups: previously healthy (no diagnosis), 1–3 diagnostic groups, or ≥ 4 diagnostic groups.

Although the term comorbidity is used throughout this thesis, particularly in relation to the Charlson Comorbidity Index, it serves as a proxy for multimorbidity, reflecting the presence of multiple coexisting chronic conditions common in older ED patients.

Table 4. Describes diagnostic groups categorized according to the International Classification of Disease-10 (ICD-10).

Diagnostic group	ICD-10
Hypertension	I10-I15
IHD	I20-I25
AF	I48
HF	I50
CVI	I60-I69
DM	E10-E14
COPD	J43-J45
Musculoskeletal pain	M05-M06, M15-M19, M54, M48, M79
Psychiatric disorders	F00-F03, F10-F48, R54, G30
Malignancy	C00-C97

Note; IHD = ischemic heart disease, AF = atrial fibrillation, HF = heart failure, CVI = cerebrovascular insult, DM = diabetes mellitus, COPD = chronic obstructive pulmonary disease.

Crowding: defined as when the identified need for emergency services exceeds available resources for patient care in the ED, hospital or both.

ED LOS: the measure of the proportion of patients with a total LOS under 4 hours has been used in several regions in Sweden since 2010. It is considered as a key indicator of patient flow management, quality of care and efficiency at the ED (264).

High-frequency users: was identified as patients with ≥ 5 visits in primary health care (PCP), ≥ 4 ED-visits, or ≥ 3 admissions to the hospital (265-268).

In-hospital bed occupancy: occupancy was calculated by dividing the number of occupied beds by the number of staffed beds available in the hospital during different times.

In-hospital LOS/bed-days: calculated as number of bed-days for patients in the study group that was admitted to the hospital after visiting the ED.

Non-specific complaint: a medical term used to describe symptoms that are vague and do not point to a specific diagnosis or organ system. NSC are common among older adults and can make management challenging. Examples of NSC are fatigue, generalized weakness, altered mental status and unexplained or recurrent falls.

Older adults: defined as ≥ 65 years. This is a definition used in many countries for defining older people, often aligning with retirement age, access to senior benefits and healthcare services. In gerontological research older adults are often classified in subgroups such as young-old (65-74 years), middle-old (75-84 years) and oldest-old (85 years and older) (269). The classification young-old, middle-old and oldest-old were used in this doctoral thesis.

Data collection

Region Skåne

Data on in-hospital bed-occupancy were obtained from the hospital managements occupancy databased at Helsingborg Hospital. Information regarding ED visits was retrieved from Patientliggaren®, an ED information system that registers every patient visit. This system records each patient's personal identity number, time of initial registration, time of discharge, discharge destination and details about the ED visit, such as main complaint, triage priority and the responsible staff member. High compliance in entering these key variables is ensured as ED staff rely on the system to track patient location and manage care. In-hospital bed-occupancy was categorized as <95%, 95-100%, 100-105% and >105%, with <95% used as the reference category because it reflects the hospital's median occupancy (270). Referral status for ED patients was retrieved from the billing system PASiS. Information from Patientliggaren® had to be included since PASiS does not include data on triage priority nor time of discharge from the ED.

PAPER I: Age and other individual data, including triage priority, were extracted from Patientliggaren® using each patient's unique personal identification number. Although a patient's triage priority may change during an ED visit, this study used the initial registered priority because it best reflects how quickly a patient is seen and evaluated by an ED physician. All patients who were registered and assessed in primary triage in Patientliggaren® during 2011-2012 were included in the study. There were no reported data crashes during the study period which could influence the results.

Region Halland

Data was obtained from the Regional Healthcare Information Platform (RHIP), a system that integrates pseudo-anonymized information on healthcare encounters and utilization within in Region Halland. RHIP is a unique data system that integrates information from primary care, prehospital care, care at the EDs and hospital care. Both public and private care givers in the region uses the same electronic medical record system and all care facilities are incorporated into RHIP. The key strengths of RHIP are that it covers both individual patient and provider data across multiple care units and over long periods of time. Data for this thesis was extracted from RHIP and included patient data and healthcare utilization from EDs, PHC centres, hospital inpatient and outpatient care. By using routinely collected data from standard clinical care, RHIP provides a comprehensive and reliable resource for analysing healthcare delivery and outcomes. An approved project and analytical plan from an Ethical Review Board in Sweden are required to gain research access to RHIP (271).

PAPER II: The study included all patients ≥ 65 years who were registered in MHC in Halmstad between October 2014 and April 2016. Data regarding healthcare utilization during the seven months before the implementation of the mobile team intervention (October 2014 – April 2015) were compared with those during a seasonally matched seven-month period after the intervention started (October 2015 – April 2016). For patients receiving MHC, data was collected from electronic records of Halmstad municipality. Demographic variables were age, gender and comorbidities. CCI was used to calculate degree of comorbidities using a scale of mild, moderate and severe. Variables for healthcare utilization were ED visits, admissions, bed-days, contacts with out-patient care and primary care. The number of primary care visits were divided into PCP visits, PCP home-visits and visits to primary care nurses. High-utilizers were defined as patients who made ≥ 4 ED visits, ≥ 3 admissions or ≥ 5 visits to primary care during each of the study periods. All patients included in the study were residents of Halmstad municipality and received their healthcare services within the municipality. This approach allowed for an evaluation of changes in healthcare utilization associated with the mobile team intervention.

PAPER III: The study period was from January 2016 to December 2016 and included patients ≥ 65 years, visiting one of the two EDs in Region Halland. For this study patients who visited the ED with chief complaint dyspnea, chest pain, abdominal pain or NSC were included. Trauma was the leading cause of ED visit during the study period but was excluded from the study due to the broad variability in symptoms and severity levels associated with trauma cases. Dyspnea, chest pain and abdominal pain were selected as they represented the top three reasons for ED-visits aside from trauma. Flow-chart for inclusion in the study are shown in figure 3.

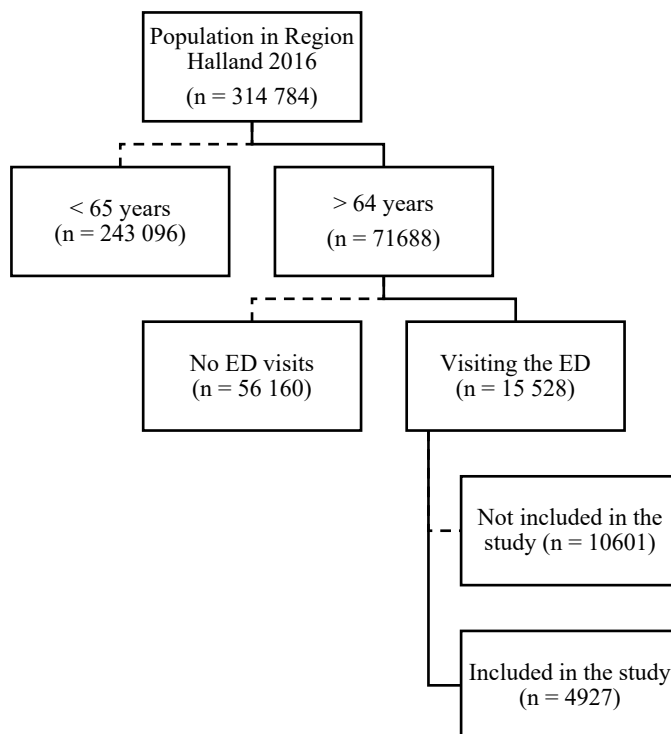


Figure 3. Flow-chart for inclusion in study III.

The NSC category included presentations such as generalized weakness, fatigue, altered mental status and other non-specific complaints. Comorbidities present prior to each patient's first ED visit in 2016 were identified using ICD-10 codes and categorized to previously healthy (no diagnosis), 1–3 diagnostic groups, or ≥ 4 diagnostic groups.

To reduce data inconsistencies, only the first ED visit during the study period was registered for patients with multiple visits.

PAPER IV: The study included patients ≥ 65 years visiting one of the two ED in Region Halland during January 2018 – December 2018. Vital signs were registered during triage according to RETTS-A, patients without any registered vital signs were excluded from the study. Vital signs were categorized based on intervals used in earlier studies (141). Only the first set of vital signs in the ED were collected for each patient. Comorbidities for the included patients were calculated using CCI and was based on diagnoses prior to the ED-visit across all caregivers in the region.

Outcome measures

PAPER I: The primary outcome was the number of visits to primary triage that resulted in ED admissions, examined in relation to different levels of in-hospital bed occupancy. Secondary outcome measures included demographic characteristics (sex and age), as well as the shift, day of the week, whether the visit occurred during periods of high ED inflow and 72h revisits.

PAPER II: Primary outcome was the number of ED-visits, admission rate and in-hospital LOS before and after the implementation of the mobile team in MHC. Secondary outcome measures were mortality rate, demographic characteristics and contacts with PHC.

PAPER III: Hospital admissions and 30-days mortality was the primary outcome measure. Secondary outcome measures were comorbidities, LOS at the ED and in-hospital LOS.

PAPER IV: The primary outcome was 7-days mortality after visiting the ED. Secondary outcome measures were LOS at the ED, admission rate and in-hospital LOS.

Data analysis

Descriptive statistics

Descriptive statistics were used to summarize patient demographics and vital sign distributions across all papers. Continuous variables were presented as means with standard deviations (SD), while categorical variables were summarized as frequencies and percentages.

Assessment of normality

The distribution of continuous variables (SBP, HR, SpO₂, RR, temperature, and LOC) was assessed through visual inspection of histograms and evaluation of skewness and kurtosis. Skewness indicated asymmetry in the distribution, with values close to zero suggesting normality. Kurtosis measured the presence of outliers, with values near 3 indicating a distribution similar to the normal distribution (272). These methods were applied in Paper IV to identify potential distributional abnormalities. Although some variables exhibited non-normal distributions, the large sample sizes justified the use of parametric methods. Based on the Central Limit Theorem, the sampling distribution of the

mean approximates normality as sample size increases, making t-tests and ANOVA statistically sound even for skewed data (273-275).

Group comparisons

To compare means between two independent groups, Student's t-tests were used, while one-way ANOVA was applied to examine differences across three or more groups (276). In Paper IV, ANOVA was used to analyse variations in ED visits, hospital admission rates, and bed-days across different age groups. Categorical associations, such as differences in comorbidity distributions by age, were assessed using the Chi-square test. ANOVA was chosen over the Kruskal–Wallis test because it offers greater statistical power when assumptions of approximate normality and homogeneity of variances are reasonably met, conditions supported by the large sample size and the Central Limit Theorem. ANOVA facilitates post hoc testing and enables more flexible modelling approaches. While the Kruskal–Wallis test is preferable in cases of clearly non-normal or ordinal data, the characteristics of the variables analysed in this study justified the use of ANOVA. Categorical associations, such as differences in comorbidity distribution across age groups, were evaluated using the Chi-square test.

Regression analyses

In Paper I, binary logistic regression models were constructed to analyse associations between hospital crowding and patient outcomes. The models were adjusted for sex, age group (0-1, 1-18, 18-40, 40-70, >70 years), shift (0:00-8:00, 8:00-16:00, 16:00-0:00), day of the week, and ED inflow. Both Wald and likelihood ratio tests were used to assess variable influence within the models.

In Paper II, negative binomial regression was used to evaluate adverse events (ED visits or in-hospital admissions) between the pre-intervention and intervention groups. Adjustments were made for gender, age, and comorbidities using the CCI. Negative binomial regression was chosen over Poisson regression due to data overdispersion.

In Paper III, Cox proportional hazards regression was applied to analyse 30-day mortality while adjusting for gender, age, comorbidities, ED LOS, hospital admission, revisit within 72 hours, and 30-day readmission. Cox regression was applied in order to account for multiple covariates and time-to-event data (277).

In Paper III, additional multivariable logistic regression analyses were conducted to examine the association between specific chief complaints—NSC, dyspnea, chest pain, and abdominal pain—and the risk of hospital admission. These analyses were further stratified by age group, level of comorbidity, and ED LOS to explore subgroup-specific patterns.

Predictive modelling: ROC/AUC analysis

To explore the predictive performance of vital signs for 7-day mortality, ROC curve analysis was conducted in Paper IV. The Area Under the Curve (AUC) provided a summary measure of each variable's discriminative ability, with higher AUC values indicating better predictive performance (278, 279). The interpretation of AUC-values is shown in table 5.

Table 5. Interpretation of AUC-values

AUC-value	Interpretation
0.5	No discriminative power
0.6-0.7	Poor
0.7-0.8	Fair
0.8-0.9	Good
>0.9	Excellent

Sensitivity and specificity at optimal cut-offs were relatively low for all individual vital signs, suggesting limited clinical accuracy when used alone. To enhance interpretability and align with clinical practice, vital signs were categorized using established clinical thresholds and prior research.

Categorization and logistic regression

Vital signs were categorized into clinically meaningful groups to facilitate binary logistic regression analysis in Paper IV. Categories are shown in table 6. Vital sign reference categories were selected to enable a stepwise analysis of risk gradients, prioritizing the relationship between physiological extremes and mortality over traditional normal ranges (280).

Table 6. Vital sign categories used for analysis in older ED patients.

Vital sign	Categories	Units
Systolic blood pressure (SBP)	≤ 80 , 81–100, 101–120, 121–140, 140–160, ≥ 160	mmHg
Heart rate (HR)	≤ 50 , 51–75, 76–100, 101–125, > 125	Beats per minute (bpm)
Oxygen saturation (SpO ₂)	≤ 80 , 81–85, 86–90, 91–95, 96–100	Percent (%)
Respiratory rate (RR)	≤ 9 , 10–19, 20–29, ≥ 30	/per minute
Temperature	≤ 30 , 31–34, 35–37, 38–39	Celsius (°C)
Level of consciousness (LOC)	3–8, 9–12, 13–15	Glasgow Coma Scale (GCS)

Binary logistic regression models were used to analyse the association between these categories and 7-day mortality, adjusting for age, sex, and comorbidities. Univariable models were first applied to assess crude associations. Multivariable models were then constructed, and odds ratios (OR) and adjusted odds ratios (AOR) with 95% confidence intervals (CI) were reported (281).

Model validation

To ensure validity, multicollinearity among predictors in Paper IV was assessed using Variance Inflation Factor (VIF) and Tolerance values. A VIF < 5 and Tolerance > 0.1 were considered acceptable, confirming that no significant multicollinearity was present (282).

In Paper I, post hoc power analyses were conducted to confirm that the sample size was sufficient to detect differences in ED admissions and 72-hour revisits across hospital bed occupancy strata ($< 95\%$, 95–100%, 100–105%, $> 105\%$). These strata were chosen based on known capacity thresholds, with $< 95\%$ used as a reference (270). Post hoc power analysis provided insight into the likelihood of Type II errors and confirmed the adequacy of the study's design.

A p-value < 0.05 was considered statistically significant. The analyses were executed with IBM SPSS Statistics 27, Armonk, New York, USA (283).

Ethical review

This doctoral thesis is based on four retrospective studies involving pseudonymized patient data retrieved from electronic health records. The data were fully pseudonymized before analysis, ensuring that no individual could be identified, and all results are presented at the group level. As there was no direct contact with patients and no interventions involved, the requirement for individual informed consent was waived in accordance with Swedish ethical regulations. At no point were any individuals exposed to identifiable personal data or risk of harm.

All studies were conducted in accordance with the ethical standards of the Declaration of Helsinki and applicable national regulations. The first study was conducted using data from Helsingborg Hospital in Region Skåne and received ethical approval from the Regional Ethical Review Board in Lund under approval number 2013/11. Studies 2 through 4 were conducted using data from Region Halland and were approved under ethical approval number 2016/20, also granted by the Regional Ethical Review Board in Lund.

The ethical application for the Region Halland studies was approved in 2016, and the first data retrieval occurred later the same year. However, the implementation of new national data protection regulations in April 2016, aligning with the European General Data Protection Regulation (GDPR), led to an administrative pause in many ongoing and planned research activities in Region Halland. As a result, access to data and related processes were delayed. Further disruptions were caused by the COVID-19 pandemic in 2020, which led to widespread reallocation of clinical and research resources, putting many healthcare-related research projects on hold, including this one.

Despite these external delays, all four studies included in this thesis were carried out in full compliance with ethical approvals and legal requirements. Data management and ethical oversight was maintained throughout the research process to ensure the protection and confidentiality of all individuals included in the datasets.

AI language model

Portions of the language editing and rephrasing in this thesis were generated with the assistance of an artificial intelligence (AI) language model. The AI was used exclusively to enhance clarity, grammar, and overall readability. All substantive content, analysis, and conclusions remain the original work of the author, and any AI-generated contributions were carefully reviewed and integrated into the final version.

Results

Paper I

A total of 160 462 visits were registered at Helsingborg Hospital during 2011-2012. For primary triage 37 129 visits were registered and 53% of these visits were admitted to the ED. Of the patients that were referred from primary triage around 9% had a 72h revisit to the ED. Patients aged 70 years or older had a higher percentage of ED admissions and 72-hour revisits compared to younger patients shown in figure 4-5.

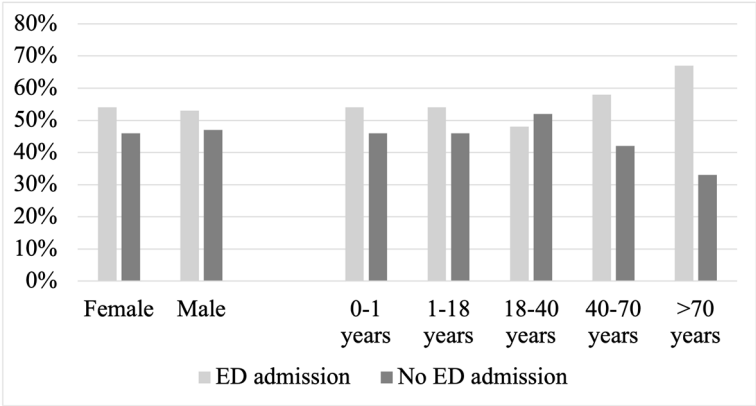


Figure 4. Difference in ED admission based on gender and age-group.

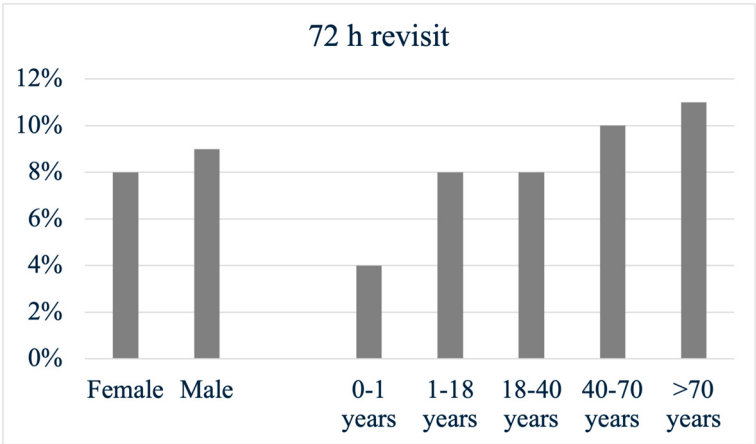


Figure 5. Illustrate percentage of revisits to the ED within 72 h divided by gender and age-group.

A significant difference in ED admissions was observed only at an occupancy level of 100-105 % compared to less than 95%. This finding did not persist in the multivariate analysis after adjusting for several factors; gender, age-group, shift, day of week, registration by a nurse compared to a secretary, presentation on shift with high triage input and presentation on shift with high ED input. There were no significant differences in 72-hour revisit in association with in-hospital bed-occupancy in neither of the models after adjusting for previously listed factors.

Paper II

The study included all patients over 65 years receiving MHC in Halmstad, Region Halland, during two study periods: October 2014–April 2015 for the pre-intervention group and October 2015–April 2016 for the intervention group. A total of 2 163 patients were included in the pre-intervention group, while 2,197 patients in the intervention group had access to the mobile team. The mean age in both groups was 84 years. No statistically significant differences were observed between the groups regarding age, gender or comorbidity burden.

Figure 6 illustrates the average healthcare utilization for both groups. The intervention group showed a statistically significant increase in PCP visits, while nurse visits within PHC decreased. No significant differences were observed between the groups regarding ED visits, hospital admissions or total bed-days.

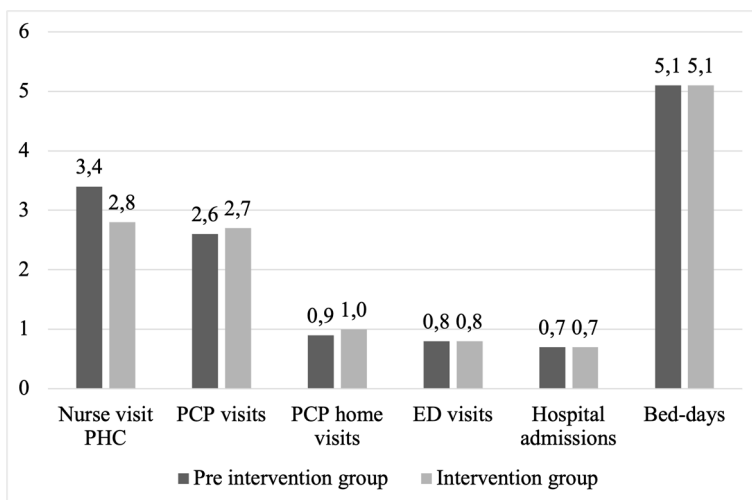


Figure 6. Average care consumption for the control group compared to patients who had access to the mobile team intervention.

Note: PHC = primary health care, PCP = primary care physician, ED = emergency department.

In both groups, 4% of patients were classified as high utilizers based on frequent ED visits. A higher proportion of patients in the intervention group (21%; n=473) made more than five visits to PCPs compared to 18% (n=395) in the pre-intervention group. Regarding hospital admissions, 8% of patients in both groups experienced more than three hospitalizations during the study period. The risk of adverse events, including ED visits and hospital admissions was higher for patients with severe comorbidities (IRR = 3.14, CI: 1.91-5.15). The incidence rate in the intervention group showed a slight decline, but the reduction was not statistically significant (IRR = 0.91, CI 0.82-1.01).

Paper III

In 2016 15 528 patients aged 65 years or older presented to the ED. The top-10 chief complaint for all visits to the ED are shown in figure 7. Among these 4 927 patients were included in the study based on their chief complaint, which included chest pain, abdominal pain, dyspnea and NSC.

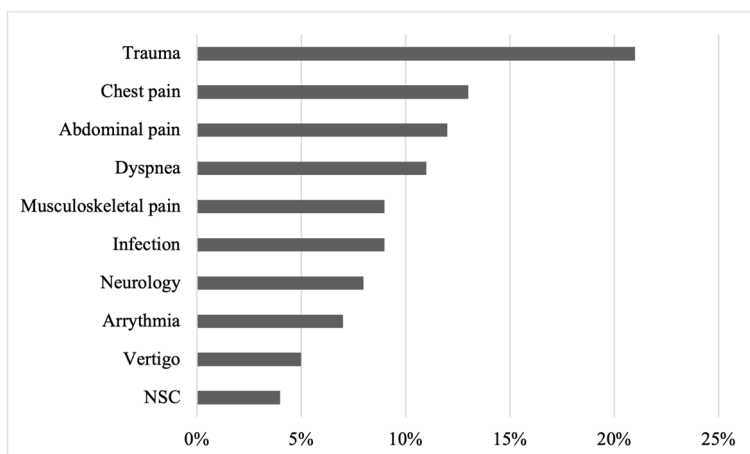


Figure 7. Top-10 chief complaints registered during ED-visits.

Note: NSC = Non-specific complaint.

For included patients 525 (11%) had NSC as chief complaint. Patients with NSC and dyspnea had a slightly higher average age (80 years) compared to patients with chest pain (77 years) and abdominal pain (78 years). Patients with dyspnea and NSC had the highest admission rate (79% vs 70%). Whereas those with NSC had a significantly higher LOS at the ED, and once admitted had a longer in-hospital LOS compared to patients with dyspnea, chest pain and abdominal pain.

In the study cohort the overall 30-days mortality rate was 6%. Patients presenting with dyspnea had the highest mortality at 10%, followed by those with NSC at 9%, abdominal pain at 5% and chest pain at 2%. Figure 8 illustrates LOS in the ED, admission rate and 30-days mortality for respectively chief complaint in the study.

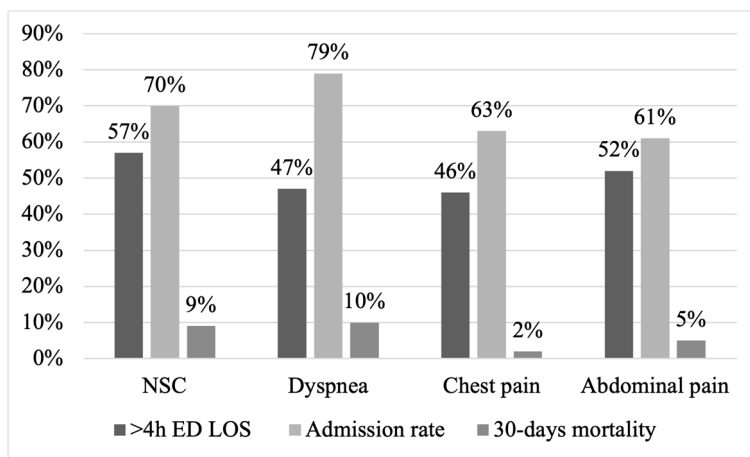


Figure 8. LOS in the ED, admission rate and 30-days mortality for NSC, dyspnea, chest pain and abdominal pain. Note: NSC = Non-specific complaint, ED LOS = Emergency department length of stay.

The risk of 30-day mortality was analyzed using Cox regression, with NSC as the reference category. The overall analysis showed a hazard ratio of 1.12 (CI 0.80–1.58) for dyspnea, indicating a slightly increased but non-significant risk compared to NSC. In contrast, chest pain and abdominal pain were associated with significantly lower mortality risks, with hazard ratio of 0.23 (CI 0.15–0.36) and 0.53 (CI 0.36–0.77), respectively. Illustrated in table 7.

Table 7. Cox regression for 30-days mortality

Chief complaint	Hazard ratio	95 % C.I.	p-value
NSC	Ref.		<0.001
Dyspnea	1.12	0.8-1.58	
Chest pain	0.23	0.15-0.36	
Abdominal pain	0.53	0.36-0.77	

Figure 9-12 visually represents the adjusted Cox regression model, showing the hazard ratios for NSC, dyspnea, chest pain, and abdominal pain, accounting for potential confounders.

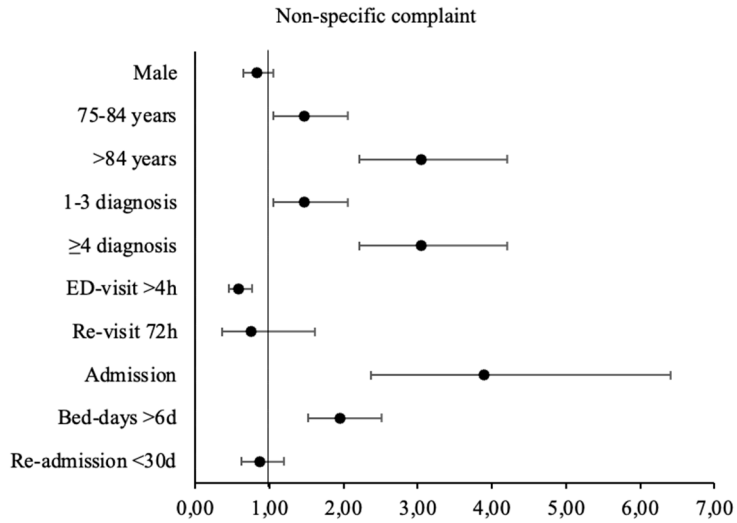


Figure 9. Forest plot illustrating adjusted hazard ratios for 30-day mortality for patients with NSC.

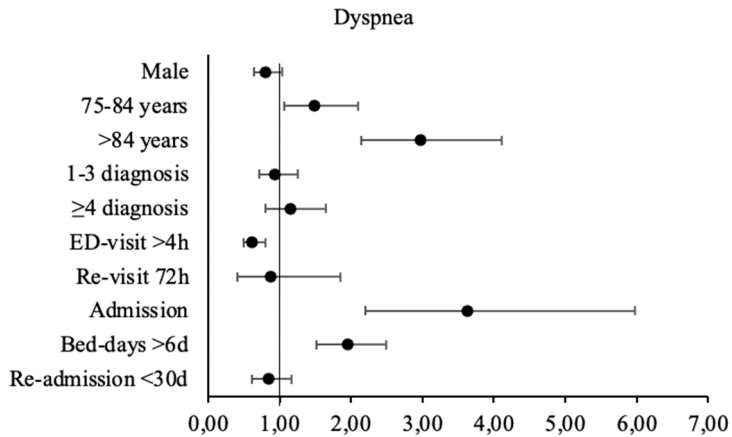


Figure 10. Forest plot illustrating adjusted hazard ratios for 30-day mortality for patients with dyspnea

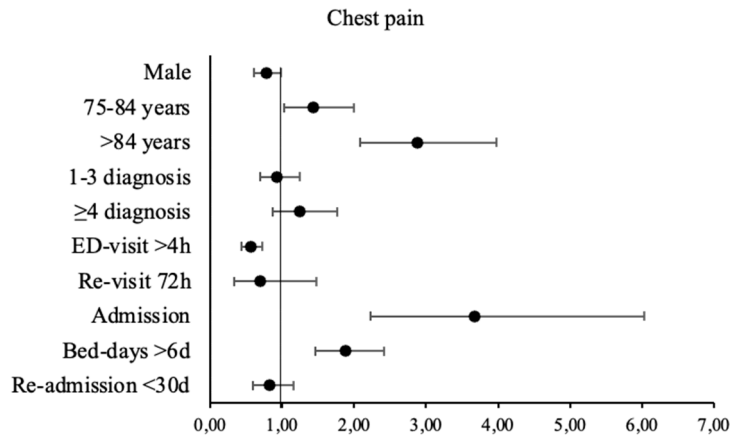


Figure 11. Forest plot illustrating adjusted hazard ratios for 30-day mortality for patients with chest pain

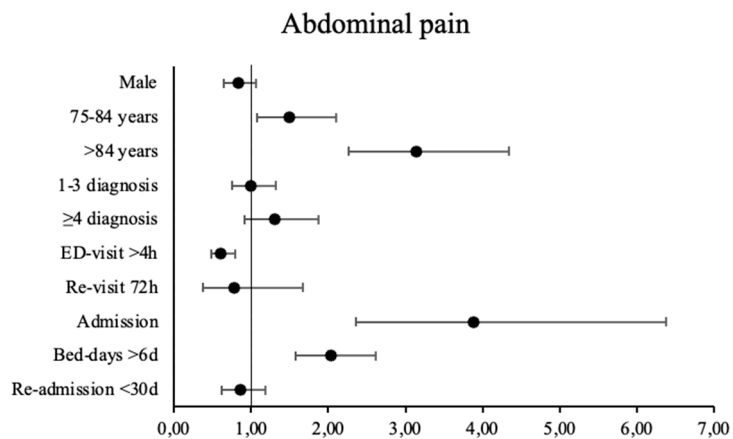


Figure 12. Forest plot illustrating adjusted hazard ratios for 30-day mortality for patients with abdominal pain

Paper IV

During 2018 30 237 patients aged ≥ 65 years visited the ED in Region Halland. Of these 4 877 (16%) were excluded due to missing vital sign measurements, resulting in a final study population of 25 450 patients. Table 8 presents the outcomes following ED arrival, including ED LOS, admission rates, and total bed-days.

Table 8. Patient outcomes following arrival at the ED for the total population and different age groups.

	Total	65–74 years	75–84 years	≥ 85 years
≥ 4 h at the ED, n (%)	12807 (50)	4698 (49)	4984 (51)	3125 (52)
Admission, n (%)	13937 (55)	4266 (44)	5455 (56)	4216 (70)
Bed-days*, mean (SD)	2.6 (4.3)	1.9 (3.7)	2.8 (4.5)	3.7 (4.6)

Note: * Bed-days are based on patients in the population that was admitted to hospital after visiting the ED.

Figure 13 shows top-10 chief complaints for patients with 7-days mortality after visit to the ED.

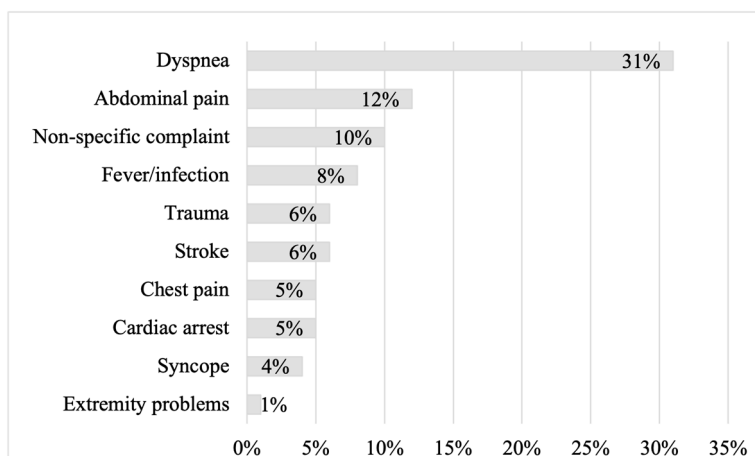


Figure 13. Top-10 chief complaints for patients with 7-days mortality after visit to the ED.

Table 9 presents the characteristics associated with ED visits for patients who died within 7 days, including arrival by ambulance, triage level, time of arrival, and duration of stay exceeding four hours.

Table 9. Characteristics associated with the visit to the ED for patients who died within 7-days.

Variables	Number of observations
<i>Arrival by ambulance, n (%)</i>	437 (90)
<i>Triage level, n (%)</i>	
Red	114 (24)
Orange	261 (54)
Yellow	78 (16)
Green	6 (1)
Blue	24 (5)
<i>Arrival time at the ED, n (%)</i>	
08.00-16.00	244 (50)
16.00-20.00	154 (32)
20.00-08.00	85 (18)
<i>≥4h in the ED, n (%)</i>	151 (31)
<i>Admission rate, n (%)</i>	433 (90)

The average vital signs in the study population were: SBP 142 mmHg, heart rate 82 beats per minute, SpO₂ 96%, respiratory rate 18 breaths per minute, and body temperature 36.8 °C. LOC was unrecorded in 7 496 cases (29%), while 17 782 patients were documented as GCS 13-15, indicating mild or no impairment.

Visual inspection of histograms showed that SBP and HR were approximately normally distributed. In contrast, SpO₂ was negatively skewed, and RR showed a positive skew with a long tail toward higher values. Body temperature was tightly clustered around the mean, with minimal variation. These patterns are illustrated in the histograms below (figure 14-18) and reflect the expected physiological distribution of vital signs in an older ED population.

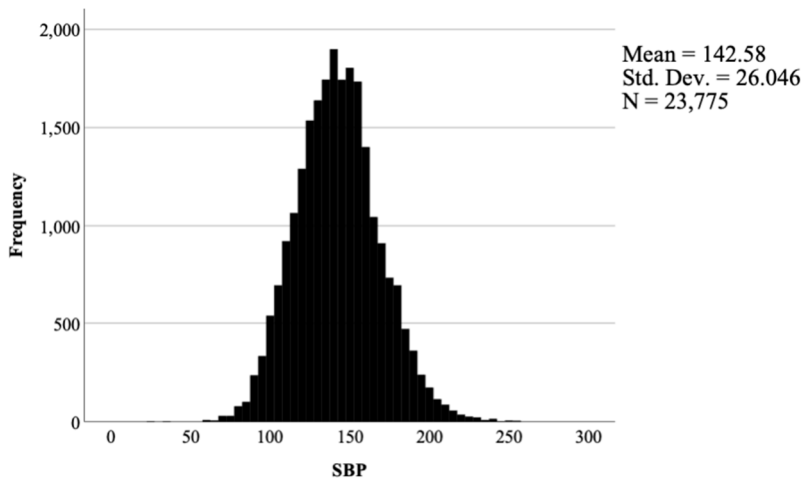


Figure 14. Distribution of systolic blood pressure at ED presentation.

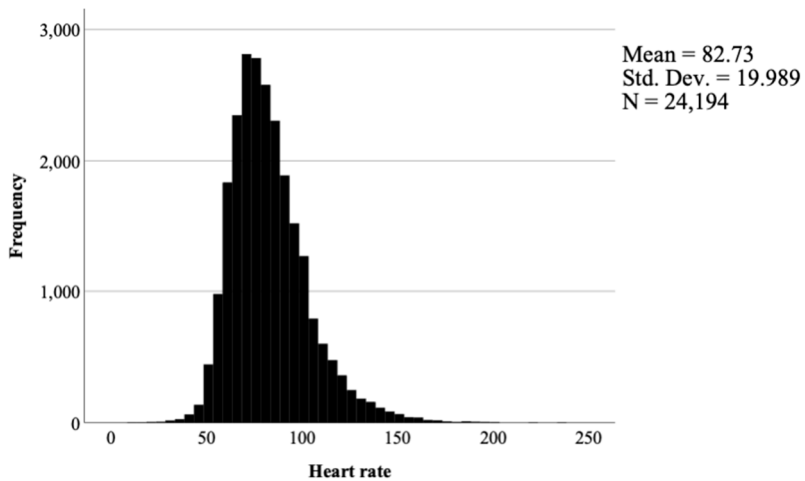


Figure 15. Distribution of heart rate at ED presentation.

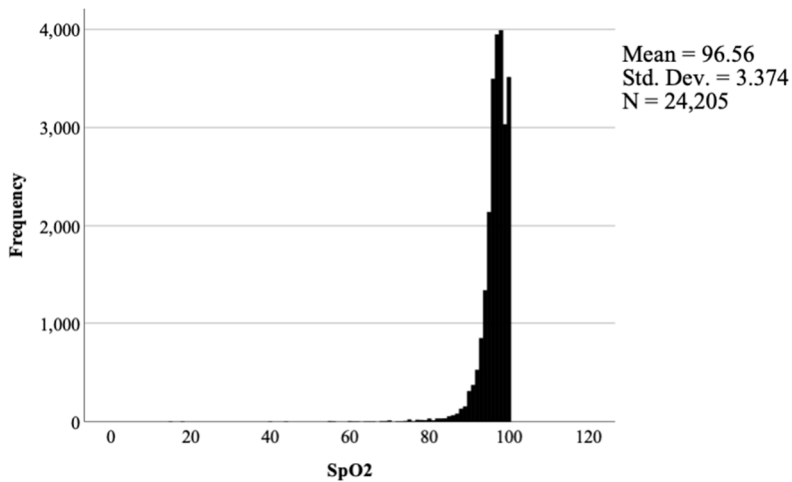


Figure 16. Distribution of oxygen saturation at ED presentation.

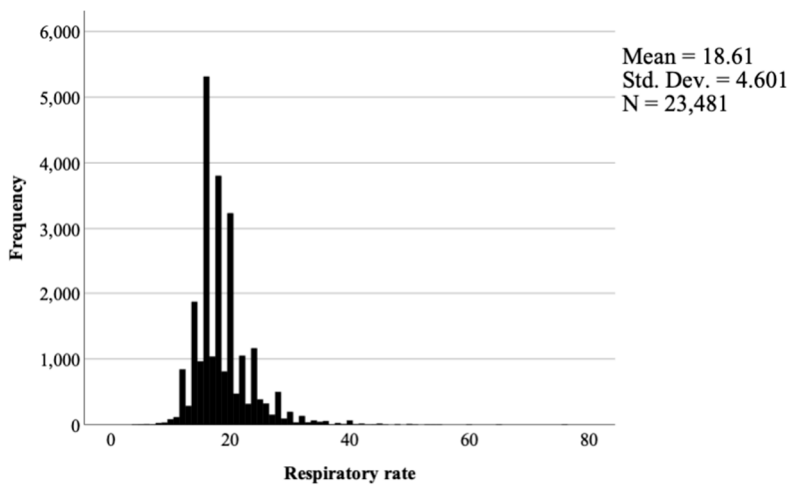


Figure 17. Distribution of respiratory rate at ED presentation.

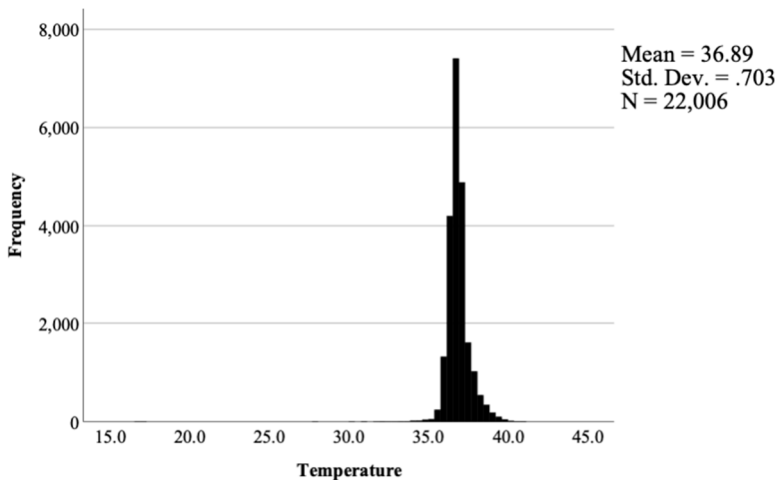


Figure 18. Distribution of body temperature at ED presentation.

ROC curve analysis demonstrated that all vital signs, except temperature, had statistically significant but limited ability to predict 7-day mortality. SBP (AUC 0.70), RR (0.69), and SpO₂ (0.68) showed the highest discriminatory ability, though with modest sensitivity (56–58%) and low specificity (21–26%). HR and LOC had lower AUC values (0.64), and temperature showed no predictive value (AUC 0.49, $p = 0.61$). Youden's Index values were low across all variables (0.02–0.36), indicating limited accuracy when used individually.

Multivariable linear regression (shown in table 10) identified impaired LOC (GCS) as the strongest predictor of 7-day mortality, followed by low SpO₂ and low SBP. Elevated respiratory and heart rates were also significantly associated with increased mortality risk, though with smaller effect sizes. All associations were statistically significant, and VIF values below 1.2 indicated no multicollinearity.

Table 10. Multivariable linear regression analysis of the association between vital signs and 7-day mortality.

Variable	Beta	p-value	Significant	VIF	Tolerance
SBP (mmHg)	-0.06	<0.001	Yes	1.03	0.97
Heart rate (beats/min)	0.04	<0.001	Yes	1.09	0.92
SpO ₂ (%)	-0.08	<0.001	Yes	1.14	0.87
Respiratory rate (/min)	0.06	<0.001	Yes	1.15	0.87
Temperature (°C)	-0.03	<0.001	Yes	1.06	0.94
LOC (GCS)	0.18	<0.001	Yes	1.01	0.99

Multivariable logistic regression identified increasing age as a significant predictor of 7-day mortality (AOR 1.08, 95% CI 1.06–1.10), while sex was not. Lower SBP was strongly associated with higher mortality: SBP 81–100 mmHg (AOR 3.73, 95% CI 2.22–6.28) and ≤ 80 mmHg (AOR 7.79, 95% CI 3.27–18.54). $\text{SpO}_2 \leq 90\%$ and heart rate > 101 bpm were also independently associated with mortality. Reduced LOC remained the most powerful predictor: GCS 9–12 (AOR 9.30, 95% CI 4.97–17.39) and GCS 3–8 (AOR 18.36, 95% CI 7.95–42.41).

Discussion

This thesis contributes to the advancement of geriatric emergency medicine by investigating critical determinants of mortality and hospitalization among older adults through four interrelated studies conducted in southern Sweden. These studies examined system-level pressures, community-based care models, diagnostic ambiguity, and early physiological markers to develop a multi-dimensional understanding of emergency care for this vulnerable population. Together, they highlight how both clinical complexity and organizational structures intersect to influence outcomes for older patients who frequently present with atypical symptoms, multiple comorbidities, cognitive impairment, and reduced physiological reserve.

Globally older adults represent a substantial and steadily increasing proportion of ED visits (102, 284, 285). Still emergency care systems remain predominantly oriented toward younger, acutely ill patients and often fail to adequately accommodate the unique needs of older individuals. This includes the challenges posed by frailty, multimorbidity, functional decline, and the diagnostic uncertainty inherent in non-specific presentations (286). Within this context, the four studies in this thesis are conceptually linked in a progression from examining systemic capacity and triage behaviour to evaluating targeted community interventions, characterizing high-risk symptom presentations, and identifying physiological indicators of early deterioration. This progression offers an integrated, evidence-based framework for improving risk recognition and clinical decision-making in geriatric emergency care.

Paper I address organizational responsiveness to capacity strain and its influence on triage behaviour. Paper II follows by evaluating a physician-led intervention aimed at mitigating ED demand through community-based care. Paper III sharpens the clinical focus, examining a diagnostically ambiguous but prognostically important presentation of NSC. Finally, Paper IV explores the prognostic utility of initial vital signs in older ED patients, highlighting their potential and their limitations.

Paper I examined how hospital crowding, as measured by in-hospital bed occupancy, influences triage decisions in the ED. The triage process remained largely stable, even slightly more permissive during periods of crowding suggesting system resilience. However, this stability also pointed to a lack of flexibility in adapting to real-time clinical

vulnerability. These findings underscore the limitations of reactive input management and highlight the need for proactive, upstream risk stratification strategies.

Building on these system-level insights, Paper II assessed whether a physician-led mobile medical team could reduce ED visits and hospitalizations among older adults in municipal home care. Although the intervention did not significantly reduce acute care utilization, it did increase contact with primary care services. The results emphasize that mobile team models are unlikely to succeed without broader multidisciplinary frameworks that incorporate nursing, allied health, and social services. This aligns closely with the structural issues identified in Paper I.

Paper III brought the focus back to the ED, exploring the clinical implications of NSC such as weakness or confusion. These presentations, often under-triaged due to their diagnostic ambiguity, were associated with the highest mortality and longest hospital stays among all chief complaints studied. The findings reinforce those from Papers I and II by demonstrating that both triage protocols and community interventions often fall short when patients present with vague but serious conditions, a hallmark of geriatric syndromes.

Finally, Paper IV evaluated the predictive value of initial vital signs for 7-day mortality in older ED patients. While low SBP, elevated HR, reduced SpO₂, and impaired LOC were all independently associated with increased mortality, their individual predictive performance was modest. Impaired LOC, a key marker of acute deterioration, was often undocumented. These results confirm and extend the findings from Paper III, demonstrating that traditional tools and thresholds used in emergency care lack sufficient sensitivity and specificity for detecting high-risk geriatric patients.

Together, these four studies form a cohesive narrative that reveals how both systemic rigidity and clinical oversimplification hinder the effective care of older adults in emergency settings. They also highlight missed opportunities for early identification of deterioration, both at triage and in community-based alternatives. The work makes a novel and important contribution to geriatric emergency medicine by articulating how multiple points of failure across the care continuum converge to compromise outcomes for this vulnerable group.

ED triage and system-level strain

ED triage remained appropriately permeable during periods of high hospital bed occupancy, suggesting that access to emergency care was not significantly restricted even under system stress. Interestingly, triage appeared slightly more permissive under crowding, possibly reflecting a risk-averse strategy among nurses, who may prioritize admission when clinical uncertainty is high. When accounting for ED inflow, this effect diminished, indicating that increased admissions were primarily volume-driven rather than a shift in

triage thresholds. The absence of an association between occupancy and 72-hour revisit rates supports the safety and appropriateness of triage decisions.

These findings reinforce the robustness of the triage process, yet they raise important questions regarding the allocation of ED resources during peak demand. There is a risk that triage units may disproportionately assess lower-acuity patients at the expense of more complex cases. System-level adaptations such as dynamic staffing models, fast-track services, enhanced coordination with primary care, and early follow-up planning may help safeguard care quality and improve throughput during times of high pressure (145, 287).

Mobile teams and emergency care utilization

The physician-led mobile care team intervention aimed at reducing ED visits and hospital admissions among older adults receiving municipal home care did not lead to significant reductions in acute care use. However, it did result in increased primary care contact, indicating improved access. Limitations in implementation including restricted hours of operation and low engagement with high-risk, high-utilizing patients likely contributed to the lack of impact. Only 4% of patients were frequent ED users, suggesting suboptimal targeting.

These findings align with earlier studies emphasizing the importance of continuity and multidisciplinary integration in care models for older adults (130, 288). While the intervention did not reduce admissions, staff reported subjective improvements in patient well-being an outcome supported in prior research (214). Systematic reviews have noted inconsistent effects of mobile teams on ED utilization and have questioned their cost-effectiveness, particularly when implemented without adequate integration and patient targeting (208, 213, 216).

Future studies should focus on better-defined intervention populations, broader operational availability, and the inclusion of patient-reported outcomes such as perceived safety, autonomy, and quality of life. Furthermore, given the observational nature of the study, it is essential to interpret the findings as associations rather than causal effects. Mixed-method and controlled trial designs are needed to evaluate the full impact and sustainability of mobile care models.

Clinical relevance of non-specific complaints

Older adults presenting with NSC, such as fatigue, weakness, and altered mental status, had longer ED stays, higher 72-hour readmission rates, and the longest in-hospital length

of stay. While dyspnea led to the highest admission rate, NSC was associated with both a higher admission risk and 30-day mortality compared to chest or abdominal pain. These results echo previous findings that NSC presentations, although often triaged as low acuity, are associated with significant adverse outcomes (62, 110, 178, 184).

NSC presentations often reflect underlying geriatric syndromes such as frailty, delirium, or functional decline, complex conditions that are difficult to assess using standard triage tools and that require nuanced evaluation (60, 62). The study underscores the need to treat NSC as indicators of geriatric vulnerability, rather than diagnostic ambiguity. Comprehensive assessment frameworks, including frailty screening and functional evaluation, may improve risk stratification and clinical outcomes for this high-risk group (289).

Vital signs as predictors of mortality

Initial vital signs including low SBP, elevated HR, low SpO₂, and impaired LOC were independently associated with increased 7-day mortality among older ED patients, aligning with previous research (135, 290-295). LOC was the most predictive individual marker, although under-documented in nearly one-third of cases. Despite their statistical associations with mortality, the predictive performance of individual vital signs was modest, with ROC AUC values ranging between 0.64 and 0.70.

These findings highlight the limitations of using single-parameter thresholds for risk stratification in older adults. Respiratory rate and temperature, while statistically significant in multivariable models, did not yield clinically useful cutoffs. Collectively, these results reinforce the importance of multifactorial, age-adjusted triage models. In clinical practice, vital signs should be interpreted alongside comorbidities, frailty, functional status, and cognitive function to support accurate decision-making.

Concluding reflections and contributions to research gaps

This thesis provides a contribution to the field of geriatric emergency medicine by linking system dynamics, community-based care, clinical phenotypes, and physiological risk markers. The integrated approach adopted across the four studies addresses key gaps in the literature:

- It demonstrates that triage practices are resilient under system-level pressure but could benefit from strategic refinement.
- It highlights the limited impact of untargeted mobile interventions and the need for more integrated, patient-specific models.
- It clarifies the prognostic importance of NSC, challenging current triage norms and supporting the inclusion of geriatric-specific risk indicators.
- It evaluates the utility and limits of vital signs in risk stratification, advocating for more nuanced, multifactorial assessment frameworks.

Integrative perspective

Taken together, these four studies converge on a single message: current emergency care systems are not adequately designed to manage the complex risks of older adults. Triage tools undervalue frailty and cognitive dysfunction. Community-based alternatives are under-integrated and poorly targeted. High-risk presentations like NSC are frequently under-recognized. And standard physiological metrics fail to capture early deterioration in geriatric patients with multimorbidity.

These limitations are documented in the geriatric emergency medicine literature, yet implementation has been slow. This thesis contributes to that evidence base by offering a coherent, empirically grounded assessment of where and why these gaps persist and what types of reforms may be required.

Strengths

This thesis offers several methodological and contextual strengths that enhance the robustness and relevance of its findings.

Population-based and unselected cohorts

Some of the studies in this thesis employed a population-based approach, including all individuals aged 65 years and older presenting to the emergency department, regardless of presenting complaint or hospital affiliation. This inclusive design reduces selection bias and supports external validity. The study populations are likely representative not only of the regional population but also of older adults in other Scandinavian healthcare systems with similar organizational structures.

Use of real-world, integrated registry data

Paper II–IV used data from RHIP, a comprehensive regional health information system integrating hospital, primary, and municipal care. This allowed for longitudinal tracking of healthcare utilization, including emergency visits, admissions, and mortality. The absence of selection based on enrolment or consent procedures reduces participation bias and enhances the validity of findings (296).

Focus on understudied but clinically relevant areas

The thesis addresses important and underexplored domains in geriatric emergency medicine, such as triage during crowding, mobile care team interventions, and NSC. By focusing on short-term outcomes such as 7-day mortality and 72-hour revisits the research identifies critical early indicators of risk, with direct implications for clinical management and healthcare planning (178).

Analytical rigor and system-level considerations

Multivariable analyses were applied to adjust for potential confounders, and subgroup analyses were conducted where relevant. Seasonal adjustments accounted for temporal variation in care demand. Healthcare system-level factors, such as hospital bed occupancy, were included, an often-overlooked variable in emergency care research that adds contextual validity to the findings (297).

Relevance for policy and clinical practice

The results have implications for the design and evaluation of alternative care models for older adults, particularly in the context of ED crowding and the increasing burden of complex geriatric patients. The work supports the importance of integrated care pathways and points to the potential benefits of enhanced home-based interventions, triage optimization, and improved recognition of high-risk presentations (298).

Limitations

Several limitations should be acknowledged in interpreting the findings of this thesis.

Study setting and generalizability

Paper I was conducted at a single ED, which inherently limits the generalizability of its findings to other settings. While the redirection of patients to alternative levels of care, such as primary care or municipal services, remains relatively uncommon internationally, it is a well-established practice in Sweden. This difference in care pathways may reduce the comparability of results to other healthcare systems (117, 299).

Data scope and registry-based design

Retrospective data were obtained from electronic medical records. Paper II–IV used data from the RHIP, which integrates healthcare utilization across hospital, primary, and municipal care in the region. This system enabled population-level analyses of individuals aged 65 years and older, minimizing selection bias by including all eligible older adults presenting to the ED. Paper I used data from a single ED and included patients across all ages. The use of registry-based data, while comprehensive, introduced certain limitations common to observational studies. These include the potential for documentation errors and missing values, for example, LOC was not recorded in approximately one-third of cases. For studies relying on RHIP, outcomes such as revisits or admissions occurring outside Region Halland may not have been captured, although such events are likely infrequent given the regionally integrated care system.

Grouped bed-occupancy levels and statistical power

Due to sample size constraints, hospital bed occupancy had to be grouped into broader categories when analysing 72-hour ED revisits. While this allowed for detection of group-level differences of 2% or more, it reduced analytical granularity and may have obscured subtler associations.

Frailty and geriatric-specific variables

While morbidity was assessed using the CCI, this measure does not adequately capture key geriatric syndromes such as frailty, functional impairment, or cognitive decline. These factors are known to be critical predictors of outcomes among older adults. Unfortunately, routine frailty assessments are not currently embedded in hospital records in Sweden, precluding their inclusion in this thesis. This omission limits the ability to fully understand risk stratification and the trajectory of vulnerable older patients (48).

Constraints in the evaluation of mobile care teams

The mobile care team intervention was limited to weekday office hours, potentially underestimating its effect on acute care use. The intervention was not specifically targeted toward high-utilizer patients who typically account for a large proportion of ED visits, potentially diluting its overall impact. The relatively low number of recorded patient contacts during the study period also limits statistical power. Moreover, the study did not assess patient-reported outcomes such as perceived safety, autonomy, or quality of life. Future research should incorporate qualitative methods to capture these important non-clinical dimensions.

Chief complaint classification and trauma exclusion

The thesis focused on NSC and high-risk chief complaints such as dyspnea, chest pain, and abdominal pain, which are well-established in the literature. Trauma, although a frequent cause of ED visits among older adults, was excluded due to its heterogeneous nature, encompassing diverse mechanisms and severity levels that are difficult to categorize meaningfully for this type of analysis. This exclusion limits the applicability of findings to trauma-related presentations, which remain a significant contributor to ED workload and geriatric morbidity (300).

Temporal and causal limitations

Most analyses focused on short-term outcomes such as 7-day mortality. While valuable for identifying immediate risks, this focus does not capture long-term health trajectories or the underlying causes of death. As with all observational studies, the findings throughout this thesis reflect associations rather than causal relationships. Although multivariable regression techniques were applied to adjust for confounding, residual confounding cannot be ruled out. Definitive conclusions regarding the causal impact of triage decisions, bed occupancy levels, or mobile team interventions require further investigation using prospective designs or randomized controlled trials.

Recommendations for future research

To address the limitations identified in this thesis and to advance the field of geriatric emergency medicine, future research should consider the following priorities:

- **Conduct prospective studies incorporating geriatric-specific variables**, such as frailty, functional status, cognitive impairment, and polypharmacy. These factors are not routinely captured in registry data but are known to significantly influence clinical outcomes in older adults. The integration of validated frailty screening instruments into electronic health records would facilitate more precise risk stratification and inform individualized care strategies.
- **Investigate long-term outcomes** among older ED patients beyond the short-term metrics (7-day mortality and 72-hour revisits) used in this thesis. Future studies should examine trajectories of functional decline, institutionalization, quality of life, and long-term mortality. Linking ED data with primary care, rehabilitation, and municipal home care records would enable a more holistic understanding of patient pathways and care transitions.
- **Evaluate the effectiveness and cost-efficiency of mobile care team interventions** through rigorously designed studies, such as randomized controlled trials. Research should assess not only reductions in acute care use but also patient-centred outcomes, including perceived safety, autonomy, and continuity of care. Tailoring interventions to high-risk or high-utilizer patient subgroups may enhance their impact and efficiency.
- **Develop and validate decision-support tools or risk stratification models** to assist in the management of NSC, which remain diagnostically challenging and are associated with worse outcomes. Given the complexity and heterogeneity of NSC, both quantitative and qualitative research is needed to improve triage accuracy and

understand how older patients experience vague or atypical presentations in emergency settings.

- **Explore the role of healthcare system-level variables** such as in-hospital bed occupancy, triage prioritization, and resource availability on clinical outcomes, safety, and patient flow. The development of systems-based simulation models could help evaluate the impact of organizational dynamics on emergency care performance and inform evidence-based policy and resource planning during periods of high demand.

By pursuing these research directions, future studies can contribute to more personalized, equitable, and systemically informed approaches to emergency care for the growing population of older adults.

Conclusion

This thesis offers a forward-looking contribution to the evolving field of geriatric emergency medicine. Through four interlinked studies, it exposes critical tensions between the growing clinical complexity of older adults and the structural limitations of emergency care systems designed for younger, acutely ill populations.

The findings reveal that triage processes remain resilient under systemic strain but not necessarily sensitive to geriatric vulnerability. Mobile care teams increase access but fall short without strategic targeting and integration. Non-specific complaints, long dismissed as diagnostically vague, emerge here as powerful predictors of poor outcomes. And while initial vital signs signal risk, their modest predictive value underscores the limitations of relying on single-parameter assessments in a population defined by complexity.

Taken together, this work challenges the current emergency care paradigm and calls for a more tailored, multifactorial, and person-centred approach. It advocates for triage systems that recognize frailty, care models that reach beyond episodic contact, and clinical tools that embrace, not overlook, the ambiguity inherent in aging.

In doing so, the thesis not only addresses persistent gaps in research but also lays a foundation for reimagining how we identify, assess, and care for older adults in emergency settings where time is short, complexity is high, and the stakes are often greatest.

Directions and clinical implications

Geriatric competence in emergency care

As the population ages, EDs increasingly serve as critical points of care for older adults, who frequently present with complex, multifactorial health issues. This demographic shift demands a corresponding evolution in ED practice, one that recognizes the unique clinical features and care needs of geriatric patients.

The findings in this thesis underscore the need for improved geriatric competence among ED staff. Traditional emergency medicine training, which often prioritizes rapid, disease-specific interventions, may not sufficiently prepare clinicians to manage the atypical presentations, polypharmacy, cognitive impairment, and functional decline frequently seen in older patients. Targeted education in geriatrics for emergency physicians, nurses, and support staff is essential.

Implementing structured training programs that cover geriatric syndromes, cognitive and functional assessment, and end-of-life care can enhance clinical decision-making and risk stratification. Practical tools, such as delirium screening instruments, frailty indices, and structured discharge planning protocols, should be integrated into ED workflows to guide personalized and appropriate care.

Incorporating frameworks such as the “4Ms” can support a more holistic, person-centred approach in the ED, even when time constraints preclude a comprehensive geriatric assessment. This is particularly valuable in high-pressure ED environments, where decisions must be made rapidly but still require consideration of long-term outcomes and the patient's overall health trajectory.

From a systems perspective, improving geriatric competence supports more effective triage, reduces unnecessary hospitalizations, and facilitates safer transitions of care. It also contributes to greater efficiency and resource use, as care can be better aligned with patients' actual needs and prognosis.

In conclusion, investing in geriatric education and embedding geriatric principles in emergency care delivery is not only clinically necessary but also strategically beneficial for health systems facing rising geriatric demand. Strengthening geriatric competence in EDs is a key step toward delivering safer, more effective, and more dignified care for older adults.

Implement frailty and delirium screening in the ED

Routine screening for frailty and delirium in older adults at the ED enables early identification of high-risk patients, targeted clinical interventions and contributes to improved care and clinical outcomes.

Screening for frailty

Frailty is a well-established predictor of adverse outcomes in older adults, including increased mortality, longer hospital stays, functional decline, and readmissions [1–3]. Early identification of frailty in the emergency department (ED) is essential for guiding clinical decision-making and tailoring care pathways.

Although various screening tools exist, such as CFS and FRESH, the priority in the ED should be to identify frailty, not necessarily to grade its severity. Recognition alone enables timely interventions, such as geriatric assessment, palliative care consultation, or enhanced discharge planning, which may improve outcomes even in the absence of formal scoring.

Despite its clinical value, frailty screening is not routinely implemented or documented in many EDs, limiting its potential impact on continuity of care. Integrating brief, feasible tools into standard ED practice could help ensure that frailty is recognized and acted upon early.

Screening for delirium

Delirium is a common but underdiagnosed condition in older adults at the ED. Delirium is associated with higher mortality, prolonged hospitalization and increased use of healthcare resources. Early detection by screening is necessary to identify and treat underlying causes.

Recognizing both frailty and delirium in the ED can support more informed clinical decision-making, including the need for hospital admission, targeted interventions, or safe discharge with appropriate follow-up. Early identification of patients at higher risk of complications enables ED staff to prioritize care, reduce crowding, and enhance overall care efficiency. As frail older adults are particularly susceptible to delirium a common but frequently missed acute condition, routine delirium screening should be integrated alongside frailty assessments. Together, these evaluations can improve risk stratification and contribute to better outcomes for the geriatric population in emergency care settings.

Implement protocols for non-specific complaints in the ED

Older adults frequently present to the ED with NSC, which often lack localized or classic signs of illness. This makes rapid assessment and diagnosis particularly challenging. Given the diagnostic complexity and vulnerability of this population, there is a clear need for tailored clinical protocols that support early recognition of serious underlying conditions in older patients presenting with NSC. In addition to protocol development, targeted training in geriatric emergency medicine is crucial. Enhancing ED staff knowledge of atypical presentations, geriatric syndromes, and age-related physiological changes can significantly improve clinical decision-making. Routine assessments for frailty and delirium should also be considered, as these are common, underrecognized contributors to poor outcomes in older adults.

These strategies: tailored protocols, ongoing education, and systematic screening, can improve diagnostic accuracy, ensure timely and appropriate care, reduce unnecessary admissions, and ultimately enhance the safety and quality of emergency care for the aging population.

Geriatric-adapted triage

Tailored triage methods for older adults could be a way forward in improving the care for older adults at the ED. This population often presents with atypical symptoms, multiple comorbidities, and unique physiological responses that standard triage protocols may not adequately capture. Traditional triage systems are generally designed around the presentation of acute, singular complaints common in younger populations. In contrast, older adults may exhibit subtle or non-specific signs of severe illness, making it more challenging to assess their true level of urgency using conventional methods.

By developing and implementing triage protocols that account for age-specific factors (such as frailty, cognitive impairment, polypharmacy and the presence of multiple chronic conditions) healthcare providers can improve the accuracy of urgency assessments. A triage system for older adults could facilitate identification of critical conditions, ensuring that older patients receive prompt and appropriate care, which is vital for reducing complications and preventing deterioration.

Improved triage for geriatric patients can lead to:

- *Reduced morbidity and mortality*: Early and accurate identification of high-risk patients
- *Optimized use of resources*: Accurate triage helps ensure that limited resources at the ED are directed toward those most in need, reducing overcrowding and waiting time.
- *Enhanced patient satisfaction and safety*: A system that acknowledges the complex needs of older adults can lead to better overall care and higher levels of patient trust and satisfaction.
- *Improved care coordination*: Tailored triage protocols can facilitate better communication and coordination for the team at the ED which is essential for managing the multifaceted health issues common in older populations.

Future research should focus on the development and validation of triage tools specifically tailored for older patients. These tools should incorporate clinically feasible predictors such as frailty indicators, functional impairment, and altered mental status. A simple, rapid scoring system should be designed for use at triage and tested for its ability to predict outcomes such as short-term mortality, hospital admission, and ED revisits.

Initial model development should include retrospective validation using large datasets, followed by prospective testing in real-world ED settings to assess usability, accuracy, and impact on care delivery. Ideally, such models would function as an adjunct to existing triage systems, adding a geriatric-informed risk layer to support early decision-making.

Collectively, these changes can help close critical gaps in emergency care for older adults improving early risk identification, care delivery, and health outcomes in this vulnerable and growing population.

Populärvetenskaplig sammanfattning

Bakgrund

En åldrande befolkning innebär stora utmaningar för sjukvården, särskilt inom akutsjukvården där äldre patienter ofta är sköra och har flera sjukdomar samtidigt. Äldre patienter söker ofta med diffusa symptom som kan vara svåra att tolka på en akutmottagning. Användningen av flera läkemedel i kombination med samsjuklighet kan påverka mätvärden som används vid bedömning och prioritering på akutmottagningen. Mätvärden som ofta används är puls, blodtryck, syresättning, andningsfrekvens, temperatur och bedömning av medvetandegrad. Äldre personer är mer sårbara än yngre, de söker oftare vård på akutmottagningen och har en ökad risk för komplikationer och död i samband med akutbesök och sjukhusinläggningar. Detta ställer särskilda krav på handläggningen på akutmottagningen. De system som används för att identifiera potentiellt livshotande tillstånd är i huvudsak utvecklade för yngre patienter och har därför begränsad känslighet för diffusa symptom och subtila förändringar i mätvärden som är vanligt hos äldre personer. Denna avhandling undersöker nyckelfaktorer som påverkar besök på akutmottagningen, andel som läggs in på sjukhus och dödlighet inom akutsjukvård för äldre patienter, med målet att optimera vården och stärka patientsäkerheten. Genom att identifiera och analysera riskfaktorer för äldre patienter i samband med ett akutbesök kan forskningen bidra med kunskap som kan användas för att förbättra vårdprotokoll, koordinera vården effektivare samt minska riskerna för äldre patienter i samband med akutmottagningsbesök och sjukhusvistelser. Att möta dessa utmaningar är avgörande för att säkerställa att framtidens akutsjukvård kan tillgodose behoven hos en växande äldre befolkning.

Metod

Avhandlingen bygger på hälsodata från Region Skåne samt Region Halland mellan 2011–2018. I avhandlingens första del registrerades 160 462 besök på akutmottagningen i Helsingborg mellan 2011–2012. I detta arbete låg fokus på triagering på akutmottagningen samt om det fanns kopplingar mellan tillgången på vårdplatser på sjukhuset och prioritering av vårdnivå på akutmottagningen. Hypotesen var att fler patienter hänvisas från akutmottagningen till exempelvis primärvården när belastningen på sjukhuset är högre. I avhandlingens andra delen utvärderades ett nystartat mobilt hembesöksteam i Region

Halland där målet med införandet var att minska antalet akutmottagningsbesök bland äldre patienter med kommunal hemsjukvård. Syftet med denna del av avhandlingen var att utvärdera om mängden akutbesök samt sjukhusinläggningar minskade efter införandet av ett mobilt hembesöksteam. Tredje delen i avhandlingen analyserade om det fanns några skillnader i inläggningsfrekvens och dödlighet mellan olika vanliga sökorsaker hos äldre patienter på akutmottagningen. Studien genomfördes med data från akutmottagningar i Region Halland under 2016. Under 2016 registrerades 15 528 akutbesök där patienterna var äldre än 65 år. De som sökte med andfåddhet, bröstsmärta, buksmärta och diffusa symptom inkluderades vilket ledde till en studiepopulation på 4927 patienter. I den fjärde och sista delen av avhandlingen analyserades mätvärden (blodtryck, puls, syresättning, andningsfrekvens, temperatur och medvetandegrad) på akutmottagningarna i Region Halland för 25 450 äldre patienter. Syftet var att identifiera om det fanns några associationer mellan olika mätvärden och ökad risk för död.

Resultat

I avhandlingens första del registrerades 37129 besök där 53% fick stanna kvar för bedömning på akutmottagningen. Äldre patienter fick stanna på akutmottagningen för en bedömning i något högre utsträckning än yngre patienter. Andelen hänvisningar från akutmottagningen ökade inte när det var brist på vårdplatser på sjukhuset. Andra delen i avhandlingen kunde visa att de patienter i hemsjukvården som hade tillgång till ett mobilt hembesöksteam hade lite fler kontakter med sin läkare i primärvården men studien kunde inte visa på någon minskning när det gäller akutbesök, inläggningar eller antal vårddygn. Avhandlingens tredje del kunde visa att patienter som söker med andfåddhet och ospecifika symptom hade högst dödlighet och lades in på sjukhuset i högre utsträckning än patienter som sökte för bröst- eller buksmärta. Resultaten från den fjärde delen av avhandlingen kunde visa att patienter med lågt blodtryck, hög puls, låg syresättning i blodet samt påverkad medvetandegrad hade en ökad dödlighet. Bedömning av medvetandegrad missades eller fanns inte registrerade i 29% av fallen.

Diskussion/slutsats

Avhandlingen belyser flera utmaningar för akutsjukvården och behovet av att anpassa bedömningen och omhändertagande utifrån äldre patients förutsättningar. Första bedömningen på akutmottagningen fungerar effektivt även när det är brist på vårdplatser på sjukhuset vilket säkerställer att medicinska bedömningar inte äventyras. Tvärtom så verkar fler patienter släppas in på akutmottagningen när sjukhuset har en hög belastning vilket tyder på en försiktig strategi som borde gynna äldre patienter som ofta har ett behov av en noggrann utredning. Intentionen att minska antalet inläggningar och akutbesök genom ett mobilt hembesöksteam hade ingen tydlig effekt vilket antyder att mer riktade insatser för patienter med hög vårdkonsumtion kan behövas. Äldre patienter med ospecifika symptom hade längre vårdtider och en ökad risk för död vilket understryker behovet av tydliga riktlinjer för denna patientgrupp. Äldre patienter med påverkad medvetandegrad har en ökad risk för död men det missas ofta i den första bedömningen på akutmottagningen vilket betonar behovet av att rutinmässigt screena för påverkat mentalt status för att tidigt kunna behandla bakomliggande orsaker.

Sammantaget framhäver resultaten från de olika delarna i avhandlingen behovet av att anpassa akutsjukvården efter de särskilda förutsättningar som finns hos många äldre patienter för att öka patientsäkerheten, optimera resursanvändningen och förbättra vårdkvaliteten för denna växande och sårbara patientgrupp.

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References

1. Hempenius L, Slaets JPJ, Boelens MAM, van Asselt DZB, de Bock GH, Wiggers T, et al. Inclusion of frail elderly patients in clinical trials: Solutions to the problems. *Journal of Geriatric Oncology*. 2013;4(1):26-31.
2. van Marum RJ. Underrepresentation of the elderly in clinical trials, time for action. *Br J Clin Pharmacol*. 2020;86(10):2014-6.
3. Aminzadeh F, Dalziel WB. Older adults in the emergency department: a systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. *Ann Emerg Med*. 2002;39(3):238-47.
4. Sauter TC, Capaldo G, Hoffmann M, Birrenbach T, Hautz SC, Kämmer JE, et al. Non-specific complaints at emergency department presentation result in unclear diagnoses and lengthened hospitalization: a prospective observational study. *Scand J Trauma Resusc Emerg Med*. 2018;26(1):60.
5. Salvi F, Morichi V, Grilli A, Giorgi R, Spazzafumo L, Polonara S, et al. A geriatric emergency service for acutely ill elderly patients: pattern of use and comparison with a conventional emergency department in Italy. *J Am Geriatr Soc*. 2008;56(11):2131-8.
6. Ouyang L, Yu S, Hu Z, Lin Y, Liu D. Enhancing emergency department triage for older patients: a prospective study on the integration of the identification of seniors at risk. *BMC Emerg Med*. 2025;25(1):91.
7. Alshibani A, Alharbi M, Conroy S. Under-triage of older trauma patients in prehospital care: a systematic review. *Eur Geriatr Med*. 2021;12(5):903-19.
8. Ivic R, Kurland L, Vicente V, Castrén M, Bohm K. Serious conditions among patients with non-specific chief complaints in the pre-hospital setting: a retrospective cohort study. *Scand J Trauma Resusc Emerg Med*. 2020;28(1):74.
9. Wachelder JJH, Stassen PM, Hubens L, Brouns SHA, Lambooij SLE, Dieleman JP, et al. Elderly emergency patients presenting with non-specific complaints: Characteristics and outcomes. *PLoS One*. 2017;12(11):e0188954.
10. Mooijaart SP, Carpenter CR, Conroy SP. Geriatric emergency medicine—a model for frailty friendly healthcare. *Age and Ageing*. 2022;51(3).
11. Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: A systematic review of causes, consequences and solutions. *PLoS One*. 2018;13(8):e0203316.
12. Van den Heede K, Van de Voorde C. Interventions to reduce emergency department utilisation: A review of reviews. *Health Policy*. 2016;120(12):1337-49.
13. Arsenaault-Lapierre G, Henein M, Gaid D, Le Berre M, Gore G, Vedel I. Hospital-at-Home Interventions vs In-Hospital Stay for Patients With Chronic Disease Who Present to the Emergency Department: A Systematic Review and Meta-analysis. *JAMA Netw Open*. 2021;4(6):e2111568.

14. Lurie T, Adibhatla S, Betz G, Palmer J, Raffman A, Andhavarapu S, et al. Mobile integrated health-community paramedicine programs' effect on emergency department visits: An exploratory meta-analysis. *The American Journal of Emergency Medicine*. 2023;66:1-10.
15. Lowthian JA, McGinnes RA, Brand CA, Barker AL, Cameron PA. Discharging older patients from the emergency department effectively: a systematic review and meta-analysis. *Age Ageing*. 2015;44(5):761-70.
16. Bonfichi A, Ceresa IF, Piccioni A, Zanza C, Longhitano Y, Boudi Z, et al. A Lethal Combination of Delirium and Overcrowding in the Emergency Department. *J Clin Med*. 2023;12(20).
17. Li J, Clouser JM, Brock J, Davis T, Jack B, Levine C, et al. Effects of Different Transitional Care Strategies on Outcomes after Hospital Discharge—Trust Matters, Too. *Joint Commission Journal on Quality and Patient Safety*. 2022;48(1):40-52.
18. Nguyen KH, Tolia V, Hart LA. Polypharmacy in the Emergency Department. *Clin Geriatr Med*. 2022;38(4):727-32.
19. World Health Organization. Ageing and health 2024. [Internet] Geneva: WHO; 2024 [cited: 2025 Jan 4]. Available from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>.
20. Teerawichitchainan B, Low T. Causes of Population Aging. In: Gu D, Dupre ME, editors. *Encyclopedia of Gerontology and Population Aging*. Cham: Springer International Publishing; 2021. p. 838-40.
21. Statistiska Centralbyrån. Population projections for Sweden 2024. [Internet] Stockholm: SCB; 2024. [cited: 2025 Jan 4]. Available from: <https://www.scb.se>.
22. Marengoni A, Angleman S, Melis R, Mangialasche F, Karp A, Garmen A, et al. Aging with multimorbidity: a systematic review of the literature. *Ageing Res Rev*. 2011;10(4):430-9.
23. Kalseth J, Halvorsen T. Health and care service utilisation and cost over the life-span: a descriptive analysis of population data. *BMC Health Services Research*. 2020;20(1):435.
24. Ikonen JN, Eriksson JG, von Bonsdorff MB, Kajantie E, Arponen O, Haapanen MJ. The utilization of primary healthcare services among frail older adults – findings from the Helsinki Birth Cohort Study. *BMC Geriatrics*. 2022;22(1):79.
25. Bähler C, Huber CA, Brüngger B, Reich O. Multimorbidity, health care utilization and costs in an elderly community-dwelling population: a claims data based observational study. *BMC Health Serv Res*. 2015;15:23.
26. Yim VWT, Graham CA, Rainer TH. A comparison of emergency department utilization by elderly and younger adult patients presenting to three hospitals in Hong Kong. *International Journal of Emergency Medicine*. 2009;2(1):19-24.
27. Downing A, Wilson R. Older people's use of Accident and Emergency services. *Age Ageing*. 2005;34(1):24-30.
28. Skou ST, Mair FS, Fortin M, Guthrie B, Nunes BP, Miranda JJ, et al. Multimorbidity. *Nat Rev Dis Primers*. 2022;8(1):48.
29. World Health Organization. *Multimorbidity* [Internet]. Geneva: World Health Organization; 2016 [cited 2025 May 25]. Available from: <https://www.who.int/publications/i/item/multimorbidity>
30. Batstra L, Bos E, Neeleman J. Quantifying psychiatric comorbidity: Lessons from chronic disease epidemiology. *Social psychiatry and psychiatric epidemiology*. 2002;37:105-11.
31. The Lancet. Making more of multimorbidity: an emerging priority. *The Lancet*. 2018;391(10131):1637.

32. Johnston MC, Crilly M, Black C, Prescott GJ, Mercer SW. Defining and measuring multimorbidity: a systematic review of systematic reviews. *European Journal of Public Health*. 2018;29(1):182-9.
33. Jindai K, Nielson CM, Vorderstrasse BA, Quiñones AR. Multimorbidity and Functional Limitations Among Adults 65 or Older, NHANES 2005-2012. *Prev Chronic Dis*. 2016;13:E151.
34. Feinstein AR. The pre-therapeutic classification of co-morbidity in chronic disease. *Journal of Chronic Diseases*. 1970;23(7):455-68.
35. Salisbury C. Multimorbidity: redesigning health care for people who use it. *Lancet*. 2012;380(9836):7-9.
36. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;380(9836):37-43.
37. Mehta HB, Li S, An H, Goodwin JS, Alexander GC, Segal JB. Development and Validation of the Summary Elixhauser Comorbidity Score for Use With ICD-10-CM-Coded Data Among Older Adults. *Ann Intern Med*. 2022;175(10):1423-30.
38. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373-83.
39. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care*. 1998;36(1):8-27.
40. Blayney MC, Reed MJ, Masterson JA, Anand A, Bouamrane MM, Fleuriot J, et al. Multimorbidity and adverse outcomes following emergency department attendance: population based cohort study. *BMJ Med*. 2024;3(1):e000731.
41. Menotti A, Mulder I, Nissinen A, Giampaoli S, Feskens EJ, Kromhout D. Prevalence of morbidity and multimorbidity in elderly male populations and their impact on 10-year all-cause mortality: The FINE study (Finland, Italy, Netherlands, Elderly). *Journal of clinical epidemiology*. 2001;54(7):680-6.
42. Vogeli C, Shields AE, Lee TA, Gibson TB, Marder WD, Weiss KB, et al. Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs. *J Gen Intern Med*. 2007;22 Suppl 3(Suppl 3):391-5.
43. Michael CB, Matthew JR, John AM, Atul A, Matt MB, Jacques F, et al. Multimorbidity and adverse outcomes following emergency department attendance: population based cohort study. *BMJ Medicine*. 2024;3(1):e000731.
44. Harrison C, Britt H, Miller G, Henderson J. Examining different measures of multimorbidity, using a large prospective cross-sectional study in Australian general practice. *BMJ Open*. 2014;4(7):e004694.
45. Iris SSH, Amaya A-L, Ashley A, Jim D, Kamlesh K, Umesh TK, et al. Measuring multimorbidity in research: Delphi consensus study. *BMJ Medicine*. 2022;1(1):e000247.
46. Youri Y, Agathe B, Pierre-Clément T. Multimorbidity in emergency departments: urgent need for integrated care. *BMJ Medicine*. 2024;3(1):e000989.
47. Pearson-Stuttard J, Ezzati M, Gregg EW. Multimorbidity-a defining challenge for health systems. *Lancet Public Health*. 2019;4(12):e599-e600.
48. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;381(9868):752-62.

49. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 2001;56(3):M146-56.
50. Ilinca S, Calciolari S. The patterns of health care utilization by elderly Europeans: frailty and its implications for health systems. *Health Serv Res*. 2015;50(1):305-20.
51. Theou O, Squires E, Mallery K, Lee JS, Fay S, Goldstein J, et al. What do we know about frailty in the acute care setting? A scoping review. *BMC Geriatr*. 2018;18(1):139.
52. Källberg A-S, Berg LM, Skogli S, Bjurbo C, Muntlin Å, Ehrenberg A. Prevalence of frailty and associated factors in older adults seeking care at Swedish emergency departments. *BMC Geriatrics*. 2023;23(1):798.
53. Kajsa E, Katarina W, Sten L, Synneve ID. Screening for frailty among older emergency department visitors: Validation of the new FRESH-screening instrument. *BMC Emerg Med*. 2016;16(1):27.
54. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, et al. A global clinical measure of fitness and frailty in elderly people. *Cmaj*. 2005;173(5):489-95.
55. Church S, Rogers E, Rockwood K, Theou O. A scoping review of the Clinical Frailty Scale. *BMC Geriatr*. 2020;20(1):393.
56. Elliott A, Taub N, Banerjee J, Aijaz F, Jones W, Teece L, et al. Does the Clinical Frailty Scale at Triage Predict Outcomes From Emergency Care for Older People? *Ann Emerg Med*. 2021;77(6):620-7.
57. Wolf LA, Lo AX, Serina P, Chary A, Sri-On J, Shankar K, et al. Frailty assessment tools in the emergency department: A geriatric emergency department guidelines 2.0 scoping review. *J Am Coll Emerg Physicians Open*. 2024;5(1):e13084.
58. Boreskie PE, Boreskie KF. Frailty-aware Care in the Emergency Department. *Emerg Med Clin North Am*. 2025;43(2):199-210.
59. Svenska Läkaresällskapet. *Remissvar: Skörhet hos äldre – bedömning, åtgärder och uppföljning* [Internet]. 2024 [cited 2025 May 25]. Available from: <https://www.sls.se/globalassets/sls/sls/remissvar/2024/svenska-lakaresallskapet-svar-skorhet-hos-alldre.pdf>
60. Flacker JM. What is a geriatric syndrome anyway? *J Am Geriatr Soc*. 2003;51(4):574-6.
61. Olde Rikkert MG, Rigaud AS, van Hoeyweghen RJ, de Graaf J. Geriatric syndromes: medical misnomer or progress in geriatrics? *Neth J Med*. 2003;61(3):83-7.
62. Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *J Am Geriatr Soc*. 2007;55(5):780-91.
63. Huang H-H, Lin P-Y, Chen T-Y, Wang T-Y, Chang JC-Y, Peng L-N, et al. Geriatric syndromes predict mortality of people aged 75+ years in the observation room of emergency department: Towards function-centric emergency medicine. *Archives of Gerontology and Geriatrics*. 2022;100:104662.
64. De Brauwier I, Cornette P, D'Hoore W, Lorant V, Verschuren F, Thys F, et al. Factors to improve quality for older patients in the emergency department: a qualitative study of patient trajectory. *BMC Health Services Research*. 2021;21(1):965.
65. Rubenstein LZ, Stuck AE, Siu AL, Wieland D. Impacts of geriatric evaluation and management programs on defined outcomes: overview of the evidence. *J Am Geriatr Soc*. 1991;39(9 Pt 2):8S-16S; discussion 7S-8S.

66. Ellis G, Gardner M, Tsiachristas A, Langhorne P, Burke O, Harwood RH, et al. Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database Syst Rev*. 2017;9(9):Cd006211.
67. American College of Emergency Physicians, Society for Academic Emergency Medicine, American Geriatrics Society, Emergency Nurses Association. Geriatric emergency department guidelines. *Ann Emerg Med* [Internet]. 2014 May;63(5):e7–e25 [cited 2025 Feb 5]. Available from: [https://www.annemergmed.com/article/S0196-0644\(14\)00125-3/fulltext](https://www.annemergmed.com/article/S0196-0644(14)00125-3/fulltext)
68. Ellis G, Marshall T, Ritchie C. Comprehensive geriatric assessment in the emergency department. *Clin Interv Aging*. 2014;9:2033–43.
69. Harding S. Comprehensive geriatric assessment in the emergency department. *Age Ageing*. 2020;49(6):936–8.
70. Monette PJ, Schwartz AW. Optimizing Medications with the Geriatrics 5Ms: An Age-Friendly Approach. *Drugs Aging*. 2023;40(5):391–6.
71. Hwang U, Morrison RS. The geriatric emergency department. *J Am Geriatr Soc*. 2007;55(11):1873–6.
72. Chang A, Espinosa J, Lucerna A, Parikh N. Palliative and end-of-life care in the emergency department. *Clin Exp Emerg Med*. 2022;9(3):253–6.
73. Smith AK, McCarthy E, Weber E, Cenzer IS, Boscardin J, Fisher J, et al. Half of older Americans seen in emergency department in last month of life; most admitted to hospital, and many die there. *Health Aff (Millwood)*. 2012;31(6):1277–85.
74. George N, Bowman J, Aaronson E, Ouchi K. Past, present, and future of palliative care in emergency medicine in the USA. *Acute Med Surg*. 2020;7(1):e497.
75. Higginson IJ, Sen-Gupta GJ. Place of care in advanced cancer: a qualitative systematic literature review of patient preferences. *J Palliat Med*. 2000;3(3):287–300.
76. American College of Emergency Physicians. Ten things physicians and patients should question [Internet]. Dallas (TX): ACEP; 2018 [cited 2025 Mar 24]. Available from: <https://www.acep.org/siteassets/uploads/uploaded-files/acep/membership/chapters/grants/choosing-wisley-5-things-phys.pdf>
77. Prachanukool T, George N, Bowman J, Ito K, Ouchi K. Best Practices in End of Life and Palliative Care in the Emergency Department. *Clin Geriatr Med*. 2023;39(4):575–97.
78. Tay R, Tan JY, Lim B, Hum AY, Simpson J, Preston N. Factors associated with the place of death of persons with advanced dementia: A systematic review of international literature with meta-analysis. *Palliative Medicine*. 2024;38(9):896–922.
79. Maughan BC, Rabin E, Cantrill SV. A Broader View of Quality: Choosing Wisely Recommendations From Other Specialties With High Relevance to Emergency Care. *Annals of Emergency Medicine*. 2018;72(3):246–53.
80. Kane RL, Ouslander JG, Abrass IB, Resnick B. Chapter 17. Ethical Issues in the Care of Older Persons. *Essentials of Clinical Geriatrics*, 7e. New York, NY: The McGraw-Hill Companies; 2013.
81. Marks J, Predescu I, Dunn LB. Ethical Issues in Caring for Older Adults. *Focus (Am Psychiatr Publ)*. 2021;19(3):325–9.
82. Furlan L, Francesco PD, Costantino G, Montano N. Choosing Wisely in clinical practice: Embracing critical thinking, striving for safer care. *J Intern Med*. 2022;291(4):397–407.

83. Borasio GD, Jox RJ. Choosing wisely at the end of life: the crucial role of medical indication. *Swiss Med Wkly.* 2016;146:w14369.
84. Cooper Z, Courtwright A, Karlage A, Gawande A, Block S. Pitfalls in communication that lead to nonbeneficial emergency surgery in elderly patients with serious illness: description of the problem and elements of a solution. *Ann Surg.* 2014;260(6):949-57.
85. Wells TS, Wu L, Bhattarai GR, Nickels LD, Rush SR, Yeh CS. Self-Reported Hearing Loss in Older Adults Is Associated With Higher Emergency Department Visits and Medical Costs. *Inquiry.* 2019;56:46958019896907.
86. Wallace LG, Hirschman KB, Huang L, Cacchione PZ, Naylor MD. Hospitalizations, Emergency Department Visits, and Home Health Use Among Older Adults With Sensory Loss. *J Aging Health.* 2024;36(1-2):133-42.
87. Chodosh J, Goldfeld K, Weinstein BE, Radcliffe K, Burlingame M, Dickson V, et al. The HEAR-VA Pilot Study: Hearing Assistance Provided to Older Adults in the Emergency Department. *J Am Geriatr Soc.* 2021;69(4):1071-8.
88. Huddle MG, Deal JA, Swenor B, Genther DJ, Lin FR. Association Between Dual Sensory Impairment, Hospitalization, and Burden of Disease. *J Am Geriatr Soc.* 2016;64(8):1735-7.
89. Brune C, Liljas A. "You treat what you have to treat, and you don't care as much if they understand or if they feel good about it": Communication barriers and perceptions of moral distress among doctors in emergency departments. *Medicine (Baltimore).* 2023;102(50):e36610.
90. Kent T, Lesser A, Israni J, Hwang U, Carpenter C, Ko KJ. 30-day emergency department revisit rates among older adults with documented dementia. *Journal of the American Geriatrics Society.* 2019;67(11):2254-9.
91. Carpenter CR, Leggett J, Bellolio F, Betz M, Carnahan RM, Carr D, et al. Emergency Department Communication in Persons Living With Dementia and Care Partners: A Scoping Review. *Journal of the American Medical Directors Association.* 2022;23(8):1313.e15-e46.
92. Shaw CA, Gordon JK. Understanding Elderspeak: An Evolutionary Concept Analysis. *Innov Aging.* 2021;5(3):igab023.
93. Shaw C, Ward C, Gordon J, Williams K, Herr K. Characteristics of elderspeak communication in hospital dementia care: Findings from The Nurse Talk observational study. *Int J Nurs Stud.* 2022;132:104259.
94. Ambade PN, Hoffman Z, Vest T, Mehra K, Gunja M, MacKinnon BH, et al. Factors influencing communication issues during hospital discharge for older adults in 11 high-income countries: a secondary analysis of the 2021 International Health Policy Survey. *BMJ Open.* 2025;15(1):e089430.
95. Cilla F, Sabione I, D'Amelio P. Risk Factors for Early Hospital Readmission in Geriatric Patients: A Systematic Review. *Int J Environ Res Public Health.* 2023;20(3).
96. Salvi F, Morichi V, Grilli A, Giorgi R, De Tommaso G, Dessì-Fulgheri P. The elderly in the emergency department: a critical review of problems and solutions. *Intern Emerg Med.* 2007;2(4):292-301.
97. Phoemlap P, Vadcharavivad S, Musikatavorn K, Areepium N. Prevalence and factors associated with preventable drug-related emergency department visits (DREDp) in elderly patients. *BMC Emergency Medicine.* 2024;24(1):197.
98. Hesselink G, Schoonhoven L, Barach P, Spijker A, Gademan P, Kalkman C, et al. Improving patient handovers from hospital to primary care: a systematic review. *Ann Intern Med.* 2012;157(6):417-28.

99. Conroy SP, Ansari K, Williams M, Laithwaite E, Teasdale B, Dawson J, et al. A controlled evaluation of comprehensive geriatric assessment in the emergency department: the 'Emergency Frailty Unit'. *Age Ageing*. 2014;43(1):109-14.
100. Wittenberg R, Sharpin L, McCormick B, Hurst J. The ageing society and emergency hospital admissions. *Health Policy*. 2017;121(8):923-8.
101. Ukkonen M, Jämsen E, Zeitlin R, Pauniahio S-L. Emergency department visits in older patients: a population-based survey. *BMC Emergency Medicine*. 2019;19(1):20.
102. Ogliari G, Coffey F, Keillor L, Aw D, Azad MY, Allaboudy M, et al. Emergency department use and length of stay by younger and older adults: Nottingham cohort study in the emergency department (NOCED). *Aging Clinical and Experimental Research*. 2022;34(11):2873-85.
103. Socialstyrelsen. Statistik om akutmottagningar, väntetider och besök 2023. [Internet] [cited: 2025 Feb 20] Available from: <https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/artikelkatalog/statistik/2024-6-9153.pdf>.
104. Sveriges kommuner och regioner, Sweden. Statistik för akutmottagningar, 2023. [Internet] Stockholm: SKR; 2023. [cited: 2025 Feb 5]. Available from: <https://skr.se/vantetiderivarden/vantetidsstatistik/akutmottagning.54391.html>
105. Wofford JL, Schwartz E, Timerding BL, Folmar S, Ellis SD, Messick CH. Emergency department utilization by the elderly: analysis of the National Hospital Ambulatory Medical Care Survey. *Acad Emerg Med*. 1996;3(7):694-9.
106. Ciccone A, Allegra JR, Cochrane DG, Cody RP, Roche LM. Age-related differences in diagnoses within the elderly population. *Am J Emerg Med*. 1998;16(1):43-8.
107. Quinn K, Herman M, Lin D, Supapol W, Worster A. Common Diagnoses and Outcomes in Elderly Patients Who Present to the Emergency Department with Non-Specific Complaints. *Cjem*. 2015;17(5):516-22.
108. Shankar KN, Liu SW, Ganz DA. Trends and Characteristics of Emergency Department Visits for Fall-Related Injuries in Older Adults, 2003-2010. *West J Emerg Med*. 2017;18(5):785-93.
109. Choi NG, Choi BY, DiNitto DM, Marti CN, Kunik ME. Fall-related emergency department visits and hospitalizations among community-dwelling older adults: examination of health problems and injury characteristics. *BMC Geriatr*. 2019;19(1):303.
110. Vanpee D, Swine C, Vandenbossche P, Gillet JB. Epidemiological profile of geriatric patients admitted to the emergency department of a university hospital localized in a rural area. *Eur J Emerg Med*. 2001;8(4):301-4.
111. Dufour I, Chouinard MC, Dubuc N, Beaudin J, Lafontaine S, Hudon C. Factors associated with frequent use of emergency-department services in a geriatric population: a systematic review. *BMC Geriatr*. 2019;19(1):185.
112. McCusker J, Karp I, Cardin S, Durand P, Morin J. Determinants of emergency department visits by older adults: a systematic review. *Acad Emerg Med*. 2003;10(12):1362-70.
113. American College of Emergency Physicians. Emergency Department Crowding: High Impact Solutions. [Internet] Irving (TX): ACEP; 2016. [cited 2025 Feb 4]. Available from: <https://www.acep.org/administration/ed-crowding/>
114. American College of Emergency Physicians. Crowding. *Ann Emerg Med*. 2006 Jun;47(6):585. doi: 10.1016/j.annemergmed.2006.02.025. PMID: 16713796.

115. Cowan RM, Trzeciak S. Clinical review: Emergency department overcrowding and the potential impact on the critically ill. *Crit Care*. 2005;9(3):291-5.
116. Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. *Med J Aust*. 2006;184(5):213-6.
117. Anantharaman V, Seth P. Emergency department overcrowding. In: Kayden S, Anderson PD, Freitas R, Platz E, editors. *Emergency Department Leadership and Management: Best Principles and Practice*. Cambridge: Cambridge University Press; 2014. p. 257-69.
118. Pham JC, Patel R, Millin MG, Kirsch TD, Chanmugam A. The effects of ambulance diversion: a comprehensive review. *Acad Emerg Med*. 2006;13(11):1220-7.
119. Huang JA, Tsai WC, Chen YC, Hu WH, Yang DY. Factors associated with frequent use of emergency services in a medical center. *J Formos Med Assoc*. 2003;102(4):222-8.
120. Afilalo J, Marinovich A, Afilalo M, Colacone A, Léger R, Unger B, et al. Nonurgent emergency department patient characteristics and barriers to primary care. *Acad Emerg Med*. 2004;11(12):1302-10.
121. Davis B, Sullivan S, Levine A, Dallara J. Factors affecting ED length-of-stay in surgical critical care patients. *Am J Emerg Med*. 1995;13(5):495-500.
122. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. *Ann Emerg Med*. 2008;52(2):126-36.
123. Cooke MW, Wilson S, Halsall J, Roalfe A. Total time in English accident and emergency departments is related to bed occupancy. *Emerg Med J*. 2004;21(5):575-6.
124. Myndigheten för vård- och omsorg, Sweden. Vården ur befolkningens perspektiv, 65 år och äldre. [Internet] Stockholm: Rapport 2022:2. [cited 2025 Feb 5]. Available from: <https://www.vardanalys.se/rapporter/varden-ur-befolkningens-perspektiv-65-ar-och-aldre/>
125. Hansen AH, Halvorsen PA, Aaraas IJ, Førde OH. Continuity of GP care is related to reduced specialist healthcare use: a cross-sectional survey. *Br J Gen Pract*. 2013;63(612):482-9.
126. Department of Health & Social Care NHS, England. Reducing emergency admissions. [Internet] England: 2018 [cited 2025 Feb 24]. Available from: <https://www.nao.org.uk/wp-content/uploads/2018/02/Reducing-emergency-admissions.pdf>.
127. Grumbach K, Keane D, Bindman A. Primary care and public emergency department overcrowding. *Am J Public Health*. 1993;83(3):372-8.
128. Carmel AS, Steel P, Tanouye R, Novikov A, Clark S, Sinha S, et al. Rapid Primary Care Follow-up from the ED to Reduce Avoidable Hospital Admissions. *West J Emerg Med*. 2017;18(5):870-7.
129. McDonald KM, Sundaram V, Bravata DM, Lewis R, Lin N, Kraft SA, et al. AHRQ Technical Reviews. Closing the Quality Gap: A Critical Analysis of Quality Improvement Strategies (Vol 7: Care Coordination). Rockville (MD): Agency for Healthcare Research and Quality (US); 2007.
130. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q*. 2005;83(3):457-502.
131. Timmins L, Peikes D, McCall N. Pathways to reduced emergency department and urgent care center use: Lessons from the comprehensive primary care initiative. *Health Serv Res*. 2020;55(6):1003-12.
132. Avelino-Silva TJ, Steinman MA. Diagnostic discrepancies between emergency department admissions and hospital discharges among older adults: secondary analysis on a population-based survey. *Sao Paulo Med J*. 2020;138(5):359-67.

133. Skinner TR, Scott IA, Martin JH. Diagnostic errors in older patients: a systematic review of incidence and potential causes in seven prevalent diseases. *Int J Gen Med*. 2016;9:137-46.
134. Jawad BN, Pedersen KZ, Andersen O, Meier N. Minimizing the Risk of Diagnostic Errors in Acute Care for Older Adults: An Interdisciplinary Patient Safety Challenge. *Healthcare (Basel)*. 2024;12(18).
135. Kennedy M, Enander RA, Tadiri SP, Wolfe RE, Shapiro NI, Marcantonio ER. Delirium risk prediction, healthcare use and mortality of elderly adults in the emergency department. *J Am Geriatr Soc*. 2014;62(3):462-9.
136. Bo M, Bonetto M, Bottignole G, Porrino P, Coppo E, Tibaldi M, et al. Length of Stay in the Emergency Department and Occurrence of Delirium in Older Medical Patients. *J Am Geriatr Soc*. 2016;64(5):1114-9.
137. Sri-On J, Chang Y, Curley DP, Camargo CA, Jr., Weissman JS, Singer SJ, et al. Boarding is associated with higher rates of medication delays and adverse events but fewer laboratory-related delays. *Am J Emerg Med*. 2014;32(9):1033-6.
138. Roussel M, Teissandier D, Yordanov Y, Balen F, Noizet M, Tazarourte K, et al. Overnight Stay in the Emergency Department and Mortality in Older Patients. *JAMA Intern Med*. 2023;183(12):1378-85.
139. Brady A, McMackin E, Subramaniam D, Quirke C, Donnelly T, McGlynn J, et al. Safer Care for Older People in the Emergency Department. *Age and Ageing*. 2024;53(Supplement_4).
140. Sapra A, Malik A, Bhandari P. Vital Sign Assessment. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright © 2025, StatPearls Publishing LLC.; 2025.
141. Candel BG, Duijzer R, Gaakeer MI, ter Avest E, Sir Ö, Lameijer H, et al. The association between vital signs and clinical outcomes in emergency department patients of different age categories. *Emergency Medicine Journal*. 2022;39(12):903-11.
142. Cwinn MA, Forster AJ, Cwinn AA, Hebert G, Calder L, Stiell IG. Prevalence of information gaps for seniors transferred from nursing homes to the emergency department. *Cjem*. 2009;11(5):462-71.
143. Rutschmann OT, Chevalley T, Zumwald C, Luthy C, Vermeulen B, Sarasin FP. Pitfalls in the emergency department triage of frail elderly patients without specific complaints. *Swiss Med Wkly*. 2005;135(9-10):145-50.
144. Grossmann FF, Zumbrunn T, Frauchiger A, Delport K, Bingisser R, Nickel CH. At risk of undertriage? Testing the performance and accuracy of the emergency severity index in older emergency department patients. *Ann Emerg Med*. 2012;60(3):317-25.e3.
145. Farrohknia N, Castrén M, Ehrenberg A, Lind L, Oredsson S, Jonsson H, et al. Emergency department triage scales and their components: a systematic review of the scientific evidence. *Scand J Trauma Resusc Emerg Med*. 2011;19:42.
146. de Groot B, Stolwijk F, Warmerdam M, Lucke JA, Singh GK, Abbas M, et al. The most commonly used disease severity scores are inappropriate for risk stratification of older emergency department sepsis patients: an observational multi-centre study. *Scand J Trauma Resusc Emerg Med*. 2017;25(1):91.
147. Chester JG, Rudolph JL. Vital signs in older patients: age-related changes. *J Am Med Dir Assoc*. 2011;12(5):337-43.
148. Kehoe A, Rennie S, Smith JE. Glasgow Coma Scale is unreliable for the prediction of severe head injury in elderly trauma patients. *Emergency Medicine Journal*. 2015;32(8):613-5.

149. Boulton AJ, Peel D, Rahman U, Cole E. Evaluation of elderly specific pre-hospital trauma triage criteria: a systematic review. *Scand J Trauma Resusc Emerg Med.* 2021;29(1):127.
150. Lehmann R, Beekley A, Casey L, Salim A, Martin M. The impact of advanced age on trauma triage decisions and outcomes: a statewide analysis. *Am J Surg.* 2009;197(5):571-4; discussion 4-5.
151. Brown JB, Gestring ML, Forsythe RM, Stassen NA, Billiar TR, Peitzman AB, et al. Systolic blood pressure criteria in the National Trauma Triage Protocol for geriatric trauma: 110 is the new 90. *J Trauma Acute Care Surg.* 2015;78(2):352-9.
152. Su YC, Chien CY, Chaou CH, Hsu KH, Gao SY, Ng CJ. Revising Vital Signs Criteria for Accurate Triage of Older Adults in the Emergency Department. *Int J Gen Med.* 2022;15:6227-35.
153. Thorin E, Thorin-Trescases N. Vascular endothelial ageing, heartbeat after heartbeat. *Cardiovasc Res.* 2009;84(1):24-32.
154. Ooi WL, Hossain M, Lipsitz LA. The association between orthostatic hypotension and recurrent falls in nursing home residents. *Am J Med.* 2000;108(2):106-11.
155. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. *Intensive Care Med.* 2021;47(11):1181-247.
156. Warmerdam M, Baris L, van Liebergen M, Ansems A, Esteve Cuevas L, Willeboer M, et al. The association between systolic blood pressure and in-hospital mortality in older emergency department patients who are hospitalised with a suspected infection. *Emerg Med J.* 2018;35(10):619-22.
157. Klang E, Soffer S, Shimon Shahar M, Barash Y, Apter S, Konen E, et al. Association of normal systolic blood pressure in the emergency department with higher in-hospital mortality among hypertensive patients. *J Clin Hypertens (Greenwich).* 2019;21(12):1841-8.
158. Bonomo L, Larici AR, Maggi F, Schiavon F, Berletti R. Aging and the respiratory system. *Radiol Clin North Am.* 2008;46(4):685-702, v-vi.
159. Ogburn-Russell L, Johnson JE. Oxygen saturation levels in the well elderly: altitude makes a difference. *J Gerontol Nurs.* 1990;16(10):26-30.
160. MacNee W. Accelerated lung aging: a novel pathogenic mechanism of chronic obstructive pulmonary disease (COPD). *Biochem Soc Trans.* 2009;37(Pt 4):819-23.
161. Tobin MJ, Laghi F, Jubran A. Why COVID-19 Silent Hypoxemia Is Baffling to Physicians. *Am J Respir Crit Care Med.* 2020;202(3):356-60.
162. Milo-Cotter O, Cotter G, Kaluski E, Rund MM, Felker GM, Adams KF, et al. Rapid clinical assessment of patients with acute heart failure: first blood pressure and oxygen saturation--is that all we need? *Cardiology.* 2009;114(1):75-82.
163. Janssens JP, Pache JC, Nicod LP. Physiological changes in respiratory function associated with ageing. *Eur Respir J.* 1999;13(1):197-205.
164. Kenney WL, Munce TA. Invited review: aging and human temperature regulation. *J Appl Physiol* (1985). 2003;95(6):2598-603.
165. Gomolin IH, Aung MM, Wolf-Klein G, Auerbach C. Older is colder: temperature range and variation in older people. *J Am Geriatr Soc.* 2005;53(12):2170-2.
166. Jain S, Iverson LM. Glasgow Coma Scale. *StatPearls.* Treasure Island (FL): StatPearls Publishing Copyright © 2025, StatPearls Publishing LLC.; 2025.

167. Romanelli D, Farrell MW. AVPU Scale. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright © 2025, StatPearls Publishing LLC.; 2025.
168. Starmark JE, Stålhammar D, Holmgren E. The Reaction Level Scale (RLS85). Manual and guidelines. *Acta Neurochir (Wien)*. 1988;91(1-2):12-20.
169. Lucke JA, de Gelder J, Heringhaus C, van der Mast RC, Fogteloo AJ, Anten S, et al. Impaired cognition is associated with adverse outcome in older patients in the Emergency Department; the Acutely Presenting Older Patients (APOP) study. *Age and Ageing*. 2017;47(5):679-84.
170. Siddiqi N, House AO, Holmes JD. Occurrence and outcome of delirium in medical in-patients: a systematic literature review. *Age Ageing*. 2006;35(4):350-64.
171. Ryan DJ, O'Regan NA, Caoimh RÓ, Clare J, O'Connor M, Leonard M, et al. Delirium in an adult acute hospital population: predictors, prevalence and detection. *BMJ Open*. 2013;3(1):e001772.
172. Hou L, Zhang Q, Cao L, Chen M, Wang Q, Li Y, et al. Diagnostic accuracy of the 4AT for delirium: A systematic review and meta-analysis. *Asian Journal of Psychiatry*. 2023;80:103374.
173. Wei LA, Fearing MA, Sternberg EJ, Inouye SK. The Confusion Assessment Method: a systematic review of current usage. *J Am Geriatr Soc*. 2008;56(5):823-30.
174. Muser O, Seiler K, Bachnick S, Gehri B, Zúñiga F, Hasemann W. Delirium detection in hospitalized adults: the performance of the 4 'A's Test and the modified Confusion Assessment Method for the Emergency Department. A comparison study. *Bulletin of the National Research Centre*. 2022;46(1):179.
175. Han JH, Zimmerman EE, Cutler N, Schnelle J, Morandi A, Dittus RS, et al. Delirium in older emergency department patients: recognition, risk factors, and psychomotor subtypes. *Acad Emerg Med*. 2009;16(3):193-200.
176. Han JH, Bryce SN, Ely EW, Kripalani S, Morandi A, Shintani A, et al. The effect of cognitive impairment on the accuracy of the presenting complaint and discharge instruction comprehension in older emergency department patients. *Ann Emerg Med*. 2011;57(6):662-71.e2.
177. van Dam CS, Peters MJL, Hoogendijk EO, Nanayakkara PWB, Muller M, Trappenburg MC. Older patients with nonspecific complaints at the Emergency Department are at risk of adverse health outcomes. *Eur J Intern Med*. 2023;112:86-92.
178. Nemec M, Koller MT, Nickel CH, Maile S, Winterhalder C, Karrer C, et al. Patients presenting to the emergency department with non-specific complaints: the Basel Non-specific Complaints (BANC) study. *Acad Emerg Med*. 2010;17(3):284-92.
179. van der Velde M, Jansen MAC, de Jongh MAC, Kremers MNT, Haak HR. Implementation of a care-pathway at the emergency department for older people presenting with nonspecific complaints; a protocol for a multicenter parallel cohort study. *PLoS One*. 2023;18(8):e0290733.
180. Limpawattana P, Phungoen P, Mitsungrern T, Laosuankoon W, Tansangworn N. Atypical presentations of older adults at the emergency department and associated factors. *Archives of Gerontology and Geriatrics*. 2016;62:97-102.
181. Wester AL, Dunlop O, Melby KK, Dahle UR, Wyller TB. Age-related differences in symptoms, diagnosis and prognosis of bacteremia. *BMC Infect Dis*. 2013;13:346.
182. Grosmaître P, Le Vavasœur O, Yachouh E, Courtial Y, Jacob X, Meyran S, et al. Significance of atypical symptoms for the diagnosis and management of myocardial infarction in elderly patients admitted to emergency departments. *Arch Cardiovasc Dis*. 2013;106(11):586-92.

183. Perry A, Macias Tejada J, Melady D. An Approach to the Older Patient in the Emergency Department. *Clin Geriatr Med*. 2018;34(3):299-311.
184. Hofman MR, van den Hanenberg F, Sierevelt IN, Tulner CR. Elderly patients with an atypical presentation of illness in the emergency department. *Neth J Med*. 2017;75(6):241-6.
185. Labib N, Nouh T, Winocour S, Deckelbaum D, Banici L, Fata P, et al. Severely injured geriatric population: morbidity, mortality, and risk factors. *J Trauma*. 2011;71(6):1908-14.
186. De Simone B, Chouillard E, Podda M, Pararas N, de Carvalho Duarte G, Fugazzola P, et al. The 2023 WSES guidelines on the management of trauma in elderly and frail patients. *World Journal of Emergency Surgery*. 2024;19(1):18.
187. Chang DC, Bass RR, Cornwell EE, MacKenzie EJ. Undertriage of Elderly Trauma Patients to State-Designated Trauma Centers. *Archives of Surgery*. 2008;143(8):776-81.
188. Phillips S, Rond PC, 3rd, Kelly SM, Swartz PD. The failure of triage criteria to identify geriatric patients with trauma: results from the Florida Trauma Triage Study. *J Trauma*. 1996;40(2):278-83.
189. Egodage T, Ho VP, Bongiovanni T, Knight-Davis J, Adams SD, Digiacomio J, et al. Geriatric trauma triage: optimizing systems for older adults-a publication of the American Association for the Surgery of Trauma Geriatric Trauma Committee. *Trauma Surg Acute Care Open*. 2024;9(1):e001395.
190. Lundy ME, Zhang B, Ditillo M. Management of the Geriatric Trauma Patient. *Surgical Clinics of North America*. 2024;104(2):423-36.
191. National Institute on Aging. Elder abuse [Internet]. Bethesda (MD): National Institute on Aging; 2023 [cited 2025 Feb 5]. Available from: <https://www.nia.nih.gov/health/elder-abuse/elder-abuse>
192. Rosen T, Platts-Mills TF, Fulmer T. Screening for elder mistreatment in emergency departments: current progress and recommendations for next steps. *J Elder Abuse Negl*. 2020;32(3):295-315.
193. Lachs MS, Pillemer KA. Elder Abuse. *N Engl J Med*. 2015;373(20):1947-56.
194. Rosen T, Hargarten S, Flomenbaum NE, Platts-Mills TF. Identifying Elder Abuse in the Emergency Department: Toward a Multidisciplinary Team-Based Approach. *Ann Emerg Med*. 2016;68(3):378-82.
195. Stevens TB, Richmond NL, Pereira GF, Shenvi CL, Platts-Mills TF. Prevalence of nonmedical problems among older adults presenting to the emergency department. *Acad Emerg Med*. 2014;21(6):651-8.
196. Wigglesworth A, Austin R, Corona M, Schneider D, Liao S, Gibbs L, et al. Bruising as a marker of physical elder abuse. *J Am Geriatr Soc*. 2009;57(7):1191-6.
197. Murphy K, Waa S, Jaffer H, Sauter A, Chan A. A literature review of findings in physical elder abuse. *Can Assoc Radiol J*. 2013;64(1):10-4.
198. Rosen T, Stern ME, Elman A, Mulcare MR. Identifying and Initiating Intervention for Elder Abuse and Neglect in the Emergency Department. *Clin Geriatr Med*. 2018;34(3):435-51.
199. Fulmer T, Paveza G, Abraham I, Fairchild S. Elder neglect assessment in the emergency department. *Journal of Emergency Nursing*. 2000;26(5):436-43.
200. Soril LJ, Leggett LE, Lorenzetti DL, Noseworthy TW, Clement FM. Reducing frequent visits to the emergency department: a systematic review of interventions. *PLoS One*. 2015;10(4):e0123660.

201. Shumway M, Boccellari A, O'Brien K, Okin RL. Cost-effectiveness of clinical case management for ED frequent users: results of a randomized trial. *Am J Emerg Med.* 2008;26(2):155-64.
202. Okin RL, Boccellari A, Azocar F, Shumway M, O'Brien K, Gelb A, et al. The effects of clinical case management on hospital service use among ED frequent users. *Am J Emerg Med.* 2000;18(5):603-8.
203. Althaus F, Paroz S, Hugli O, Ghali WA, Daepfen JB, Peytremann-Bridevaux I, et al. Effectiveness of interventions targeting frequent users of emergency departments: a systematic review. *Ann Emerg Med.* 2011;58(1):41-52.e42.
204. Leff B, Burton L, Mader SL, Naughton B, Burl J, Inouye SK, et al. Hospital at home: feasibility and outcomes of a program to provide hospital-level care at home for acutely ill older patients. *Ann Intern Med.* 2005;143(11):798-808.
205. Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. *Cmaj.* 2007;177(11):1362-8.
206. Gonçalves S, von Hafe F, Martins F, Menino C, Guimarães MJ, Mesquita A, et al. Case management intervention of high users of the emergency department of a Portuguese hospital: a before-after design analysis. *BMC Emergency Medicine.* 2022;22(1):159.
207. Patel HY, West DJ, Jr. Hospital at Home: An Evolving Model for Comprehensive Healthcare. *Glob J Qual Saf Healthc.* 2021;4(4):141-6.
208. Arvidsson SA, Biegus KR, Ekdahl AW. The impact of a mobile geriatric acute team on healthcare consumption. *European Geriatric Medicine.* 2024;15(6):1859-65.
209. van den Broek S, Westert GP, Hesselink G, Schoon Y. Effect of ED-based transitional care interventions by healthcare professionals providing transitional care in the emergency department on clinical, process and service use outcomes: a systematic review. *BMJ Open.* 2023;13(3):e066030.
210. McGilton KS, Vellani S, Krassikova A, Robertson S, Irwin C, Cumal A, et al. Understanding transitional care programs for older adults who experience delayed discharge: a scoping review. *BMC Geriatrics.* 2021;21(1):210.
211. Karam G, Radden Z, Berall LE, Cheng C, Gruneir A. Efficacy of emergency department-based interventions designed to reduce repeat visits and other adverse outcomes for older patients after discharge: A systematic review. *Geriatr Gerontol Int.* 2015;15(9):1107-17.
212. Memedovich A, Asante B, Khan M, Eze N, Holroyd BR, Lang E, et al. Strategies for improving ED-related outcomes of older adults who seek care in emergency departments: a systematic review. *Int J Emerg Med.* 2024;17(1):16.
213. Fristedt S, Nystedt P, Skogar Ö. Mobile Geriatric Teams - A Cost-Effective Way Of Improving Patient Safety And Reducing Traditional Healthcare Utilization Among The Frail Elderly? A Randomized Controlled Trial. *Clin Interv Aging.* 2019;14:1911-24.
214. Ekdahl AW, Wirehn AB, Alwin J, Jaarsma T, Unosson M, Husberg M, et al. Costs and Effects of an Ambulatory Geriatric Unit (the AGE-FIT Study): A Randomized Controlled Trial. *J Am Med Dir Assoc.* 2015;16(6):497-503.
215. Di Pollina L, Guessous I, Petoud V, Combescure C, Buchs B, Schaller P, et al. Integrated care at home reduces unnecessary hospitalizations of community-dwelling frail older adults: a prospective controlled trial. *BMC Geriatr.* 2017;17(1):53.

216. Statens beredning för medicinsk och social utvärdering (SBU). Klinisk och hälsoekonomisk effekt av mobila team för geriatriska patienter i hemmet – en systematisk översikt. [Internet] Stockholm: SBU; 2021. [cited 2025 Feb 25] Available from:<https://www.regionorebrolan.se/contentassets/9258c6342923418896cccbde3926b8f4/2021.47-klinisk-och-halsoekonomisk-effekt-av-mobila-team-for-geriatriska-patienter-i-hemmet.pdf>
217. Wodchis WP, Dixon A, Anderson GM, Goodwin N. Integrating care for older people with complex needs: key insights and lessons from a seven-country cross-case analysis. *Int J Integr Care*. 2015;15:e021.
218. World Health Organization. World report on ageing and health [Internet]. Geneva: World Health Organization; 2015 [cited 2025 Jan 15]. Available from: <https://www.who.int/publications/i/item/9789241565042>
219. World Health Organization. Global strategy and action plan on ageing and health [Internet]. Geneva: World Health Organization; 2017 [cited 2025 Jan 15]. Available from: <https://www.who.int/publications/i/item/9789241513500>Organization
220. World Health Organization. Continuity and coordination of care: a practice brief to support implementation of the WHO Framework on integrated people-centred health services [Internet]. Geneva: World Health Organization; 2018 [cited 2025 Jan 15]. Available from: <https://www.who.int/publications/i/item/9789241514033>
221. Litzelman DK, Inui TS, Griffin WJ, Perkins A, Cottingham AH, Schmitt-Wendholt KM, et al. Impact of Community Health Workers on Elderly Patients' Advance Care Planning and Health Care Utilization: Moving the Dial. *Med Care*. 2017;55(4):319-26.
222. Hughes JM, Freiermuth CE, Shepherd-Banigan M, Ragsdale L, Eucker SA, Goldstein K, et al. Emergency Department Interventions for Older Adults: A Systematic Review. *J Am Geriatr Soc*. 2019;67(7):1516-25.
223. Preston L, Chambers D, Campbell F, Cantrell A, Turner J, Goyder E. What evidence is there for the identification and management of frail older people in the emergency department? A systematic mapping review. *Health Serv Deliv Res*. 2018;6(16). Southampton (UK): NIHR Journals Library.
224. Damery S, Flanagan S, Combes G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. *BMJ Open*. 2016;6(11):e011952.
225. Liljas AEM, Brattström F, Burström B, Schön P, Agerholm J. Impact of Integrated Care on Patient-Related Outcomes Among Older People - A Systematic Review. *Int J Integr Care*. 2019;19(3):6.
226. Bakshi S, Carlson LC, Gulla J, Wang P, Helscel K, Yun BJ, et al. Improving care coordination and reducing ED utilization through patient navigation. *Am J Manag Care*. 2022;28(5):201-6.
227. Eklund K, Wilhelmson K. Outcomes of coordinated and integrated interventions targeting frail elderly people: a systematic review of randomised controlled trials. *Health Soc Care Community*. 2009;17(5):447-58.
228. Fan L, Lukin W, Zhao J, Sun J, Hou XY. Interventions targeting the elderly population to reduce emergency department utilisation: a literature review. *Emerg Med J*. 2015;32(9):738-43.
229. Katz EB, Carrier ER, Umscheid CA, Pines JM. Comparative effectiveness of care coordination interventions in the emergency department: a systematic review. *Ann Emerg Med*. 2012;60(1):12-23.e1.

230. Bambach K, Southerland LT. Applying Geriatric Principles to Transitions of Care in the Emergency Department. *Emerg Med Clin North Am.* 2021;39(2):429-42.
231. Gupta S, Perry JA, Kozar R. Transitions of Care in Geriatric Medicine. *Clinics in Geriatric Medicine.* 2019;35(1):45-52.
232. Marsall M, Hornung T, Bäuerle A, Weigl M. Quality of care transition, patient safety incidents, and patients' health status: a structural equation model on the complexity of the discharge process. *BMC Health Services Research.* 2024;24(1):576.
233. Couture V, Germain N, Côté É, Lavoie L, Robitaille J, Morin M, et al. Transitions of care for older adults discharged home from the emergency department: an inductive thematic content analysis of patient comments. *BMC Geriatrics.* 2024;24(1):8.
234. American College of Emergency Physicians. Geriatric Emergency Department Accreditation (GEDA) Criteria [Internet]. Dallas: ACEP; [cited 2025 Feb 25]. Available from: <https://www.acep.org/siteassets/sites/geda/media/documnets/geda-criteria.pdf>
235. American College of Emergency Physicians. Geriatric Emergency Department Accreditation (GEDA) Program [Internet]. Dallas: ACEP; [cited 2025 Feb 25]. Available from: <https://www.acep.org/geda>
236. Schumacher JG. Geriatric Emergency Departments: Emerging Themes and Directions. *Current Geriatrics Reports.* 2024;13(2):34-42.
237. Ringer T, Dougherty M, McQuown C, Melady D, Ouchi K, Southerland LT, et al. White Paper-Geriatric Emergency Medicine Education: Current State, Challenges, and Recommendations to Enhance the Emergency Care of Older Adults. *AEM Educ Train.* 2018;2(Suppl Suppl 1):S5-S16.
238. Carpenter C, Lewis L, Caterino J, Wilber S, Scheatzle M, Fiorello A. Emergency Physician Geriatric Education: An Update of the 1992 Geriatric Task Force Survey. Has Anything Changed? *Annals of Emergency Medicine.* 2008;52(4):S156.
239. Hogan TM, Losman ED, Carpenter CR, Sauvigne K, Irmiter C, Emanuel L, et al. Development of geriatric competencies for emergency medicine residents using an expert consensus process. *Acad Emerg Med.* 2010;17(3):316-24.
240. Hesselink G, Demirbas M, Rikkert MO, Schoon Y. Geriatric Education Programs for Emergency Department Professionals: A Systematic Review. *Journal of the American Geriatrics Society.* 2019;67(11):2402-9.
241. Conroy S, Nickel C, Jónsdóttir A, Fernandez M, Banerjee J, Mooijaart S, et al. The development of a European curriculum in Geriatric Emergency Medicine. *European Geriatric Medicine.* 2016;7(4):315-21.
242. Kocman D, Regen E, Phelps K, Martin G, Parker S, Gilbert T, et al. Can comprehensive geriatric assessment be delivered without the need for geriatricians? A formative evaluation in two perioperative surgical settings. *Age and Ageing.* 2019;48(5):644-9.
243. Keene SE, Cameron-Comasco L. Implementation of a geriatric emergency medicine assessment team decreases hospital length of stay. *The American Journal of Emergency Medicine.* 2022;55:45-50.
244. Tinetti M, Huang A, Molnar F. The Geriatrics 5M's: A New Way of Communicating What We Do. *J Am Geriatr Soc.* 2017;65(9):2115.
245. De Mauro A, Greco M, Grimaldi M. What is big data? A consensual definition and a review of key research topics. *AIP Conference Proceedings.* 2015;1644(1):97-104.

246. Bates DW, Saria S, Ohno-Machado L, Shah A, Escobar G. Big data in health care: using analytics to identify and manage high-risk and high-cost patients. *Health Aff (Millwood)*. 2014;33(7):1123-31.
247. Burghard C. Big data and analytics key to accountable care success. *IDC health insights*. 2012;1:1-9.
248. Raghupathi W, Raghupathi V. Big data analytics in healthcare: promise and potential. *Health Inf Sci Syst*. 2014;2:3.
249. Murdoch TB, Detsky AS. The inevitable application of big data to health care. *Jama*. 2013;309(13):1351-2.
250. Mooijaart SP, Lucke JA, Brabrand M, Conroy S, Nickel CH. Geriatric emergency medicine: time for a new approach on a European level. *Eur J Emerg Med*. 2019;26(2):75-6.
251. Hunold KM, Goldberg EM, Caterino JM, Hwang U, Platts-Mills TF, Shah MN, et al. Inclusion of older adults in emergency department clinical research: Strategies to achieve a critical goal. *Acad Emerg Med*. 2022;29(3):376-83.
252. Terrell KM, Hustey FM, Hwang U, Gerson LW, Wenger NS, Miller DK. Quality indicators for geriatric emergency care. *Acad Emerg Med*. 2009;16(5):441-9.
253. Hwang U, Carpenter C, Dresden S, Dussetschleger J, Gifford A, Hoang L, et al. The Geriatric Emergency Care Applied Research (GEAR) network approach: a protocol to advance stakeholder consensus and research priorities in geriatrics and dementia care in the emergency department. *BMJ Open*. 2022;12(4):e060974.
254. Organisation for economic co-operation and development, hospital beds 2023.[cited 2025 February 10]. Available from: <https://data.oecd.org/health/hospital-beds.htm>.
255. Sveriges Kommuner och Regioner (SKR), Sweden. Fakta om vårdplatser [Internet]. Stockholm: 2022. [cited 2025 Feb 10]. Available from: <https://skr.se/skr/tjanster/rapporterochskrifter/publikationer/faktaomvardplatser.64555.html>.
256. Region Skåne, Sweden. Skåningarna blir allt äldre och befolkningen ökar långsammare [Internet]. [cited 2025 Feb 15]. Available from: <https://press.newsmachine.com/pressrelease/view/skaningarna-blir-allt-aldre-och-befolkningen-okar-langsammare-48725>.
257. Statistics Sweden. After age 60: A description of older people in Sweden. Demographic Reports 2022:2. Stockholm: 2022. [cited 2025 Feb 10]. Available from: https://www.scb.se/contentassets/c4ac9fb5ad10451aab0885b7160de9b0/be0701_2022a01_br_bce51br2202.pdf
258. Region Halland, Sweden. Sjukhuset i Halmstad: Lokalförsörjningsplan [Internet]. Halmstad: Region Halland; 2024 Jun [cited 2025 Mar 01]. Available from: https://www.regionhalland.se/download/18.6615c63d18fb79ebe40e65d0/1717076336950/Sjukhuset-i-Halmstad_Lokalforsorjningsplan_juni-2024.pdf
259. Socialstyrelsen. Statistik om äldre och personer med funktionsnedsättning efter regiform 2023 [Internet]. Stockholm: Socialstyrelsen; 2024 [cited 2025 Jan 19]. Available from: <https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/artikelkatalog/statistik/2024-4-9046.pdf>

260. Sveriges Kommuner och Regioner (SKR). Bättre liv för sjuka äldre – stora förbättringar på kort tid [Internet]. Stockholm: SKR; [cited 2025 Jan 19]. Available from: <https://skr.se/skr/tjanster/rapporterochskrifter/publikationer/battrelivforsjukaaldrestoraforbattringarpakorttid.64708.html>
261. Regeringskansliet. Överenskommelse mellan staten och Sveriges Kommuner och Regioner om god och nära vård 2023 [Internet]. Stockholm: Regeringen.se; 2023 Jan [cited 2025 Mar 24]. Available from: <https://www.regeringen.se/overenskommelser-och-avtal/2023/01/overenskommelse-mellan-staten-och-sveriges-kommuner-och-regioner-om-god-och-nara-var-d-2023/>
262. Wireklint SC, Elmqvist C, Goransson KE. An updated national survey of triage and triage related work in Sweden: a cross-sectional descriptive and comparative study. *Scand J Trauma Resusc Emerg Med.* 2021;29(1):89.
263. Ludvigsson JF, Appelros P, Askling J, Byberg L, Carrero JJ, Ekström AM, et al. Adaptation of the Charlson Comorbidity Index for Register-Based Research in Sweden. *Clin Epidemiol.* 2021;13:21-41.
264. Weber EJ, Mason S, Freeman JV, Coster J. Implications of England's four-hour target for quality of care and resource use in the emergency department. *Ann Emerg Med.* 2012;60(6):699-706.
265. LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. *Ann Emerg Med.* 2010;56(1):42-8.
266. Locker TE, Baston S, Mason SM, Nicholl J. Defining frequent use of an urban emergency department. *Emerg Med J.* 2007;24(6):398-401.
267. Longman JM, M IR, Passey MD, Heathcote KE, Ewald DP, Dunn T, et al. Frequent hospital admission of older people with chronic disease: a cross-sectional survey with telephone follow-up and data linkage. *BMC Health Serv Res.* 2012;12:373.
268. Andersson SO, Lynöe N, Hallgren CG, Nilsson M. Is frequent attendance a persistent characteristic of a patient? Repeat studies of attendance pattern at the family practitioner. *Scand J Prim Health Care.* 2004;22(2):91-4.
269. Lee SB, Oh JH, Park JH, Choi SP, Wee JH. Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. *Clin Exp Emerg Med.* 2018;5(4):249-55.
270. Blom MC, Landin-Olsson M, Lindsten M, Jonsson F, Ivarsson K. Patients presenting at the emergency department with acute abdominal pain are less likely to be admitted to inpatient wards at times of access block: a registry study. *Scand J Trauma Resusc Emerg Med.* 2015;23:78.
271. Ashfaq A, Lönn S, Nilsson H, Eriksson JA, Kwatra J, Yasin ZM, et al. Data Resource Profile: Regional healthcare information platform in Halland, Sweden. *Int J Epidemiol.* 2020;49(3):738-9f.
272. West SG, Finch JF, Curran PJ, Hoyle R. Structural equation modeling: Concepts, issues, and applications. *Structural equation models with nonnormal variables: Problems and remedies.* 1995:55-75.
273. Ghasemi A, Zahediasl S. Normality tests for statistical analysis: a guide for non-statisticians. *Int J Endocrinol Metab.* 2012;10(2):486-9.
274. Pallant J. *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*; Routledge; 2020.
275. Elliott AC, Woodward WA. *Statistical analysis quick reference guidebook: With SPSS examples*; Sage; 2007.

276. Wayne W. Daniel CLC. *Biostatistics: A Foundation for Analysis in the Health Sciences*, 11th Edition: Wiley; 2018.
277. Cox DR. Regression Models and Life-Tables. *Journal of the Royal Statistical Society: Series B (Methodological)*. 1972;34(2):187-202.
278. Zhou XH, Obuchowski NA, McClish DK. *Statistical methods in diagnostic medicine*. 2nd ed. Hoboken (NJ): Wiley-Interscience; 2002 [cited 2025 Feb 25]. Available from: <https://doi.org/10.1002/9780470906514>
279. Hajian-Tilaki K. Receiver Operating Characteristic (ROC) Curve Analysis for Medical Diagnostic Test Evaluation. *Caspian J Intern Med*. 2013;4(2):627-35.
280. Royston P, Sauerbrei W, Wiley J, Sons, Ltd. *Multivariable Model-Building. A Pragmatic Approach To Regression Analysis Based On Fractional Polynomials For Modelling Continuous Variables*. 2008.
281. Kleinbaum DG, Klein M. *Logistic regression: a self-learning text*. 3rd ed. New York (NY): Springer; 2010 [cited 2025 Feb 25]. Available from: <https://doi.org/10.1007/978-1-4419-1742-3>
282. O'brien RM. A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity*. 2007;41(5):673-90.
283. Corp. I. *IBM SPSS Statistics for Windows, Version 27.0*. Armonk, NY. IBM Corp; 2020.
284. Latham LP, Ackroyd-Stolarz S. Emergency department utilization by older adults: a descriptive study. *Can Geriatr J*. 2014;17(4):118-25.
285. Ersen T, Özcan Ö, Öncü K, Gokhan S. Cost Analysis of Recurrent Emergency Department Visits Among Patients Aged 65 and Older: A Retrospective Cross-Sectional Study. *Cureus*. 2025;17(4):e82966.
286. Hullick CJ, McNamara R, Ellis B. Silver Book II: an international framework for urgent care of older people in the first 72 hours from illness or injury. *Age Ageing*. 2021;50(4):1081-3.
287. Khanna S, Boyle J, Good N, Lind J. Unravelling relationships: Hospital occupancy levels, discharge timing and emergency department access block. *Emerg Med Australas*. 2012;24(5):510-7.
288. Lindström K, Engström S, Bengtsson C, Borgquist L. Determinants of hospitalisation rates: does primary health care play a role? *Scand J Prim Health Care*. 2003;21(1):15-20.
289. McQuown CM, Tsivitse EK. Nonspecific Complaints in Older Emergency Department Patients. *Clin Geriatr Med*. 2023;39(4):491-501.
290. Gabayan GZ, Gould MK, Weiss RE, Derosé SF, Chiu VY, Sarkisian CA. Emergency Department Vital Signs and Outcomes After Discharge. *Acad Emerg Med*. 2017;24(7):846-54.
291. Barfod C, Lauritzen MM, Danker JK, Sölétormos G, Forberg JL, Berlac PA, et al. Abnormal vital signs are strong predictors for intensive care unit admission and in-hospital mortality in adults triaged in the emergency department - a prospective cohort study. *Scand J Trauma Resusc Emerg Med*. 2012;20:28.
292. Lamantia MA, Stewart PW, Platts-Mills TF, Biese KJ, Forbach C, Zamora E, et al. Predictive value of initial triage vital signs for critically ill older adults. *West J Emerg Med*. 2013;14(5):453-60.
293. Jones AE, Aborn LS, Kline JA. Severity of emergency department hypotension predicts adverse hospital outcome. *Shock*. 2004;22(5):410-4.
294. Jones AE, Yiannibas V, Johnson C, Kline JA. Emergency department hypotension predicts sudden unexpected in-hospital mortality: a prospective cohort study. *Chest*. 2006;130(4):941-6.

295. Stanich JA, Oliveira JESL, Ginsburg AD, Mullan AF, Jeffery MM, Bellolio F. Increased short-term mortality among patients presenting with altered mental status to the emergency department: A cohort study. *Am J Emerg Med.* 2022;51:290-5.
296. Morrato EH, Elias M, Gericke CA. Using population-based routine data for evidence-based health policy decisions: lessons from three examples of setting and evaluating national health policy in Australia, the UK and the USA. *J Public Health (Oxf).* 2007;29(4):463-71.
297. Blom MC, Jonsson F, Landin-Olsson M, Ivarsson K. The probability of patients being admitted from the emergency department is negatively correlated to in-hospital bed occupancy - a registry study. *Int J Emerg Med.* 2014;7(1):8.
298. Le Berre M, Maimon G, Sourial N, Guériton M, Vedel I. Impact of Transitional Care Services for Chronically Ill Older Patients: A Systematic Evidence Review. *J Am Geriatr Soc.* 2017;65(7):1597-608.
299. Bentley JA, Thakore S, Morrison W, Wang W. Emergency Department redirection to primary care: a prospective evaluation of practice. *Scott Med J.* 2017;62(1):2-10.
300. Samaras N, Chevalley T, Samaras D, Gold G. Older patients in the emergency department: a review. *Ann Emerg Med.* 2010;56(3):261-9.

